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ABSTRACT

This curriculum guide is designed to assist junior high school industrial arts teachers in planning new courses and revising existing courses in woodworking. Addressed in the individual units of the guide are the following topics: introduction to manufacturing; laboratory management (youth leadership, entrepreneurship, and laboratory organization); wood as a material; procedures for designing, joining, planning, and material layout; safety and health environment; procedures for processing wood; procedures for finishing wood; and careers in the woodworking industry. Each unit contains some or all of the following: objectives, key words, a list of teaching aids needed, suggested references, a sentence outline, a list of materials for students, suggested student activities, student worksheets, transparency masters, student handouts, and a unit test. (MN)

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Woodworking Technology

By

Dr. Gary Winek

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Foreword

This publication is one of the new series of instructional materials for industrial arts education. It is designed to assist teachers as they plan and implement new courses of study and make revisions and improvements in existing courses. This publication is intended to help industrial arts teachers create learning environments that respond to the needs of students growing up in a complex industrial-technical society. It provides a framework that enables teachers to integrate classroom learning with real-life experiences of students.

Industrial arts is being challenged to expand and clarify its function. To meet this challenge, the industrial arts curriculum must provide opportunities for students to learn more about the technological realities in our society. This publication provides teachers with an instructional platform that focuses on industrial arts' commitment to establish its content base in the technologies.

Every effort has been made to produce a publication that addresses the unique needs of our current student population. Students with limited English proficiency (LEP) as well as handicapped, educationally disadvantaged, and nontraditional students may require modification of the material in this publication. The professional staff of EIMC will gladly work with any instructor having these students to show how the instructional material can be adapted for specific individualized instruction. Consult local, state, and federal agencies that offer assistance and guidance and that can provide sound recommendations for productive classroom management.

Kathryn R. Allen, Ph.D.
Acting Director, Extension
Instruction and Materials Center

COMPLIANCE STATEMENT

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(2) operation of school bus routes or runs on a non-segregated basis;

(3) nondiscrimination in extracurricular activities and the use of school facilities;

(4) nondiscriminatory practices in the hiring, assigning, promoting, paying, demoting, reassigning, or dismissing of faculty and staff members who work with children;

(5) enrollment and assignment of students without discrimination on the basis of race, color, or national origin;

(6) nondiscriminatory practices relating to the use of a student's first language; and

(7) evidence of published procedures for hearing complaints and grievances.

In addition to conducting reviews, the Texas Education Agency staff representatives check complaints of discrimination made by a citizen or citizens residing in a school district where it is alleged discriminatory practices have occurred or are occurring.

Where a violation of Title VI of the Civil Rights Act is found, the findings are reported to the Office for Civil Rights, Department of Health, Education and Welfare.

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TITLE VII, CIVIL RIGHTS ACT OF 1964: EXECUTIVE ORDERS 11246 and 11375; TITLE IX 1973 EDUCATION AMENDMENTS: REHABILITATION ACT OF 1973 AS AMENDED; 1974 AMENDMENTS TO THE WAGE-HOUR LAW EXPANDING THE AGE DISCRIMINATION IN EMPLOYMENT ACT OF 1967; VIETNAM ERA VETERANS READJUSTMENT ASSISTANCE ACT OF 1972 AS AMENDED IN 1974.

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Notes to the Teacher

Using the Curriculum Material

Intended Audience. The material in this curriculum package is designed for use by junior high/middle school industrial arts teachers in exploratory/introductory programs.

Length of Time for the Material. The topic of study has been developed to provide enough material for eighteen weeks of study. Individuals who teach six-, nine-, or twelve-week classes can select parts of this curriculum material as the substance of their classes.

Emphasis of the Material. Keep in mind that this curriculum material is exploratory in nature. The emphasis is on exposing students to a wide range of experiences within the topic of study rather than on the development of technical expertise in one area.

Benefits for Teachers and Students. This material is designed to assist industrial arts teachers in the classroom as they reinforce and enhance students' skills in reading, mathematics, communications, problem solving, and social interaction. In addition, teachers who use this curriculum material will be able to help their students gain an understanding of and appreciation for management and work skills needed by individuals in the world of work. The broad exposure students receive in the topic of study will assist them in making meaningful career choices.

Flexibility of the Material. This curriculum material, like any other material, cannot encompass all situations. Therefore, teachers should feel free to supplement the material with other ideas, information, or activities as needed in their particular programs.

This material can be used in a number of different ways by industrial arts teachers. Some teachers may desire to use it as the starting point, a foundation upon which to build their own courses of study. Other teachers may prefer to teach the material as it is and add to it as they feel the need. Still other teachers may pick and choose only selected parts of this curriculum for use in their classes.

Teachers may also need to make substitutions in the curriculum depending on the equipment or references available. Other circumstances may also require teachers to make curriculum substitutions. The flexibility of this material enables teachers to use it in various ways and under various conditions. This curriculum provides teachers with an alternative in course design.

Competencies. Competencies have been identified for the topic of study. As used in this material, competencies represent skills, knowledge, or attitudes that imply the ability or intelligence to accomplish a task or job. They represent the instructional intent and are stated as specific goals to be achieved. Competencies assist teachers and students in clearly formulating a purpose for learning.

Organization of the Curriculum Material

The material in this topic of study is organized into instructional units. The framework used to develop each unit consists of a number of components. These components focus on (1) outcomes, (2) materials, (3) content, (4) activities, and (5) evaluation. The components are further divided and standardized in each topic of study. An explanation of each part in the instructional unit follows.

Objectives. Objectives have been identified for each instructional unit. The objectives reflect the kind of performance necessary to successfully complete a task or job. These objectives enable a student to attain the stated competencies. Furthermore, each unit's objectives are reflected in the content, student activities, and tests for that unit.

Objectives help the teacher and the student to focus upon the important concepts to be learned in each unit. Teachers may want to duplicate the competencies and objectives and give them as handouts to the students.

Key Words: Vocabulary. New words or terms are listed to enable you to help students develop their vocabulary. Some words or terms may be listed in several units because they are used throughout a topic of study. The repetition helps reinforce vocabulary building. A student vocabulary worksheet has been included with each unit.

Teaching Aids. The materials, equipment, and supplies identified in this section will enable the teacher to plan and organize instruction better. Teachers need to review this list of teaching aids before the day of instruction since some substitutions in equipment may be needed under certain conditions. A test key has been included to help the teacher in correcting the unit test.

Each transparency in this unit is also listed. Transparency masters are provided at the end of each unit. The transparencies are keyed to a point in the sentence outline where their use is considered most appropriate. In addition to being used as transparencies, the masters may be duplicated and used as student handouts if the teacher so desires. Teachers may design or develop other transparency material that they feel enhances their instruction.

Suggested References. Many of the publications listed are available from textbook publishers. However, the reading level of these textbooks is often above junior high/middle school grade level. The material listed in this section is suggested for use by teachers as a way to supplement their knowledge in the subject area. Teachers can review these references and use selected material as supplements to their lectures and demonstrations when appropriate. Some of the sources suggested offer free or inexpensive materials that teachers may use with their students.

Sentence Outline. The information presented in this section represents the conceptual focus of the unit. The ideas and concepts are presented in a sentence outline, as a guide from which to teach. The outline should serve as a reference from which teachers can provide instruction.

The intent was not to needlessly duplicate material that is readily available to teachers. Rather, the intent was to provide teachers with basic ideas and information that may be less accessible. The suggested references and other resources can be used by teachers to build a knowledge base from which they can synthesize relevant concepts and information. Suggested references can be used to supplement, expand, and clarify learning activities and instruction.

Materials for Students. Suggestions to teachers regarding student materials may also be listed here. Student handout materials, such as exercises, charts, and graphs, are provided at the end of each unit when appropriate. These student handouts immediately follow the suggested student activities section. Handout materials may be reproduced and given to students.

Suggested Student Activities. The suggested activities are designed to reinforce and provide real applications of the concepts and content within each unit. These activities have been designed to use existing facilities and equipment, as much as possible. Another consideration was the cost factor. Suggested activities are designed to require minimum cost.

Each teacher should, therefore, examine the activities and select those which are appropriate for their students. Teachers can change or modify the suggested activities if equipment, materials, and funds are not available. Teachers need to be selective in the activities they use since some activities take longer than others. Some are designed for group activity while others are for individual work. The teacher's content emphasis must also be considered. Each of the activities has been designed to reinforce and enhance basic skills that students need in everyday life.

Tests. Each unit has a multiple-choice test to assist teachers in evaluating student achievement. Multiple-choice tests provide certain advantages for teachers in evaluating the teaching-learning process. They do not capitalize on chance answers to the extent that true-false tests do. Careful development of test answers will help teachers evaluate a student's comprehension of important concepts. This also provides teachers with an easy way to assess the effectiveness of their instruction through item analysis.

Written tests are only one method of assessing learning. Teachers will also need to evaluate a student on actual performance in each activity, on abilities, and on general progress toward reaching objectives. Each teacher should develop an evaluation system that provides the most accurate assessment of a student's progress.

Teachers may prefer to develop their own test instruments. However, their test items should focus upon objectives and course content. The test for each instructional unit in this curriculum material does focus on the objectives stated at the beginning of each unit and on unit content. A test key is also provided in the teaching aids section of each unit for the teacher's use in correcting tests.

Essential Elements

I. Essential Elements Common to All Vocational Education Programs
   A. Leadership concepts and skills
      The student shall be provided opportunities to—
      1. identify characteristics and responsibilities of leaders and effective group members;
      2. participate in orderly meetings conducted according to parliamentary procedure;
      3. function effectively on committees;
      4. plan and conduct leadership activities; and
      5. prepare for effective citizenship and participation in our democratic society.
   B. Concepts and skills related to successful employment
      The student shall be provided opportunities to—
      1. develop an awareness of employment opportunities in a chosen field;
      2. practice correct procedures for job application and interview;
      3. develop the ability to take and follow both oral and written directions;
      4. practice punctuality and dependability;
      5. observe rules and standards of the workplace;
      6. demonstrate an ability to work with others harmoniously;
      7. develop responsibility and the ability to follow through on assigned tasks; and
      8. exhibit productive work habits and attitudes.
   C. Concepts and skills associated with entrepreneurship
      The student shall be provided opportunities to—
      1. recognize opportunities and options for business ownership;
      2. identify entry-level procedures, planning processes, and terms needed to open a business; and
      3. develop an understanding of the role of small business in the free enterprise system.

II. Essential Elements Common to All Industrial Arts Programs
   A. Concepts and skills in the application of safety procedures
      The student shall be provided opportunities to—
      1. demonstrate safe operation and use of selected tools and equipment to avoid injury; and
      2. maintain safe conditions in the laboratory.
   B. Concepts and skills related to planning, designing, and problem solving
      The student shall be provided opportunities to—
      1. plan and design industrial products of the student's choice;
      2. measure accurately using metric and customary units;
      3. complete itemized list of materials; and
      4. make working drawings of projects.
   C. Concepts and skills related to the tools, materials, and process of technology
      The student shall be provided opportunities to—
      1. solve industrial problems by using a variety of industrial materials;
      2. use correctly selected hand and machine tools; and
      3. select the most suitable process to complete a project.
   D. Concepts and skills related to the past, present, and future of technology
      The student shall be provided opportunities to—
      1. recognize ideas and inventions of the past and present; and
      2. relate technological change to the skills needed for the future.
   E. Concepts and skills related to evaluating products and services of technology
      The student shall be provided opportunities to—

1. recognize good design and construction;
2. evaluate products based on given standards or applications;
3. service industrial products and equipment; and
4. develop criteria for selecting, purchasing, and contracting services.

III. Concepts and Skills Related to Production Technology

The student shall be provided opportunities to—

A. apply industrial organization and management systems by planning, organizing, and controlling production processes;
B. apply primary industrial processes of layout, testing, separating and cutting, drilling and boring, shaping and forming, casting, laminating, coating, decorating, joining, and finishing;
C. research the recycling of industrial materials;
D. plan and implement the various steps in the construction process;
E. research the transformation of raw materials into finished products;
F. plan and implement mass production activities;
G. demonstrate techniques and processes used in automated production systems; and
H. use computers in planning, production, quality control, and management of production systems.

IV. Concepts and Skills Related to Production Technology in the Area of Manufacturing

The student shall be provided opportunities to—

A. participate in activities involving product researching, designing, and marketing;
B. investigate financial resources needed in industrial production;
C. plan and implement mass production activities;
D. apply industrial organization and management systems by planning, organizing, and controlling production processes;
E. develop production charts and graphs;
F. demonstrate an awareness of automated systems used in manufacturing;
G. recognize basic material standards and terminology used in industry;
H. apply the basic industrial processes to manufacturing;
I. research the recycling of manufactured materials; and
J. use computers in planning, production, quality control, and management of production systems.

Competencies for Woodworking

- Learn to identify and know the use of different kinds of wood.
- Read and develop a working drawing to construct a woodworking industrial product.
- Demonstrate different wood fastening methods and when to use them properly.
- Demonstrate safe practices in using hand and power tools, materials, and processes.
- Understand basic woodworking processes and apply them correctly to assignments or products.
- Comprehend and apply the basic techniques of woodworking finishing operations.
- Develop pride in workmanship and positive work habits.
- Discuss how to become a wise consumer of goods related to woodworking.
- Develop an interest in the craft of woodworking as an enjoyable leisure time activity and profitable hobby.
- Demonstrate an awareness of career opportunities for competent persons within the woodworking industries.
- Develop leadership talents.

1

Introduction to Manufacturing

INTRODUCTION

This chapter is intended to be a general introduction to the manufacturing industry. It has been through manufacturing that the world has increased its standard of living. The world has more material items such as cars, furniture, and homes because of efficient manufacturing.

The students should be made aware of the importance of studying manufacturing and how manufacturing affects their lives. This broader understanding should help students see how particular manufacturing industries in wood, metal, plastics, and other materials fit into the much larger picture.

OBJECTIVES

After students have covered the material in this unit, they should be able to—

1. tell why they should study production technology;
2. describe manufacturing technology;
3. distinguish between primary and secondary manufacturing processes;
4. distinguish between part, subassembly, and product manufacturing;
5. give examples of current manufacturing devices;
6. identify and describe the three basic types of manufacturing: custom, continuous, and intermittent;
7. define **prototype;**
8. give examples of flexible control devices;
9. list some of the causes of pollution; and
10. list the types of pollution.

KEY WORDS: VOCABULARY

The words listed below may be new to the student studying woodworking. Instructors should help students understand these words as they are used in this topic of study.

production technology
primary manufacturing processes
custom manufacturing
intermittent manufacturing
computer numerical control
prototype
ultrasonic cutting
tracers
electrical discharge machining
pollution
manufacturing
secondary manufacturing processes
continuous manufacturing
numerical control
adaptive control
electrochemical machining
laser micromachining
electron beam machining
robotics
recycling

TEACHING AIDS

- Overhead projector
- Test Key: 1-B, 2-C, 3-A, 4-C, 5-D, 6-A, 7-B, 8-D, 9-C, 10-D, 11-A, 12-B, 13-C, 14-D, 15-A, 16-B, 17-B, 18-D, 19-A, 20-D, 21-B, 22-A, 23-D, 24-B, 25-C, 26-D, 27-A, 28-C

- Transparencies: You will find transparencies W1-1 through W1-15 at the end of this unit. If you wish, these masters may be duplicated in quantity and given as handouts to the students while they are studying different aspects of this unit.
  - W1-1: Industry
  - W1-2: Manufacturing
  - W1-3: Manufacturing Processes: Woodworking
  - W1-4: Examples of Woodworking Processes
  - W1-5: Examples of Woodworking Processes (cont.)
  - W1-6: Examples of Woodworking Processes (cont.)
  - W1-7: Laser Micromachining
  - W1-8: Electron Beam Machining
  - W1-9: Electrical Discharge Machining
  - W1-10: Robotics
  - W1-11: Flow Process Chart
  - W1-12: Conventional NC System
  - W1-13: Computer Numerical Control System
  - W1-14: Adaptive Control System
  - W1-15: Common Pollution Problems

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SENTENCE OUTLINE

I. Why study production technology?
   A. Production technology includes the study of processes: construction and manufacturing.
   B. Production technology includes the study of materials: plastics, metals, woods.
      1. A material is a solid, liquid, or gas out of which a thing is made.
      2. Woodworking includes the study of substances composed of woods, wood products, and wood by-products.

II. What is manufacturing?
   A. Manufacturing, as an enterprise, is a factory-based, profit-making organization. (Transparency W1-1)
   B. Manufacturing usually includes the making of products in large quantities by hand and machine. (Transparency W1-2)
      1. Part manufacturing produces basic components for a product.
      2. Subassembly manufacturing is the joining of two or more parts to form a portion of a product.
      3. Product manufacturing is the joining of two or more parts and/or subassemblies to produce a completed product.
   C. Primary manufacturing processes include activities that convert raw materials into industrial materials (standard stock).
   D. Secondary manufacturing processes include activities that convert standard stock into consumable products. (Transparencies W1-3, W1-4, W1-5, W1-6)
   E. Current manufacturing devices (examples)
      1. Electrochemical machining (ECM) uses electrical and chemical energies to act as the cutting edge of the tool.
      2. Ultrasonic cutting uses high velocity to bombard the workpiece with abrasives which machine away microscopic particles without heat.
      3. Laser micromachining is used for removal of extremely small amounts of material. (Transparency W1-7)
      4. Tracers are used on cutting machines to produce copies of parts.
      5. Electron beam machining (EBM) cuts by alternately heating and cooling the area to be cut with emitted electrons. (Transparency W1-8)
      6. Electrical discharge machining (EDM) removes small particles with an electric arc. (Transparency W1-9)
      7. Robotics combines mechanical, electrical, and computer technology. (Transparency W1-10)
         a. Multiple arm robots are becoming commonplace.
         b. Mobile robots are making headway into industrial applications.
         c. Many current jobs are being phased out by robots: welding, spray painting, die casting, heat treating.

III. Three basic types of manufacturing
   A. Custom manufacturing
      1. Custom manufacturing is the oldest type of manufacturing.
      2. Custom manufacturing depends on highly skilled workers who usually use simple machines and hand tools.
      3. This method of manufacturing is seldom used to produce consumer products.
      4. Specialization of skills has replaced the "broad total craftsman" who carried out the production of a product from start to finish.
      5. Custom manufacturing principles are used in building prototypes and unusual one-of-a-kind items.
         a. A prototype is anything of a certain shape, size, and quality—in which all parts work—that will be copied.
         b. Prototypes are built and tested prior to the selection of a final product design.

B. Continuous manufacturing
   1. Continuous manufacturing is based on a constant uniform flow of parts or products from one operation to another. These parts are usually not stored along the line. (Transparency W1-11)
   2. Equipment is arranged to handle the step-by-step sequence of operations by moving the material in a fixed predetermined path: elevators, conveyors, chutes, etc.
   3. Continuous manufacturing is used when large numbers of identical products are needed.

C. Intermittent manufacturing
   1. In intermittent manufacturing, the material is moved in "lots" by forklifts, tractors, cranes, etc.
   2. Machines are grouped according to the process they perform: grinding machines together, lathes and milling machines together, etc.
   3. The majority of parts produced across the spectrum of industries involve lots of fifty or less at the time.
      a. Intermittent manufacturing is used when the volume is too low to support a single production line—large products such as airplanes are not made by the thousands.
      b. It is also used when continuous manufacturing is not practical.
   4. Many parts of subassemblies used in continuous manufacturing are manufactured using intermittent techniques.
   5. Flexible control devices have resulted from intermittent manufacturing of a variety of parts in smaller quantities (10—1,000).
      a. Numerical control (NC)—using punch tape—became an integral part of computer-aided manufacturing during the early 1970s. (Transparency W1-12)
      b. The microcomputer—with control information drawn from the electronic memory—allowed direct input at the machine location, and is referred to as computer numerical control (CNC). (Transparency W1-13)
      c. Adaptive control (AC)—a system that can sense differences in process variables—determines the optimum speed and feed during the actual machining and makes changes to improve or optimize the performance. (Transparency W1-14)

IV. Manufacturing and the environment
   A. America is a victim of energy and environmental problems.
   B. Pollution is caused by automobiles, airplanes, home heating units, hospitals, power plants, and other machines. (Transparency W1-15)
   C. The primary cause of pollution, however, is technology.
      1. We produce and utilize—nothing more is taught.
      2. Recycling must be a part of technology: waste products back into raw materials.
   D. Types of pollution
      1. Air pollution—caused primarily by the combustion of materials.
      2. Water pollution—caused by the discharge of individual, municipal, industrial, and agricultural waste.
      3. Soil pollution—caused by any substance added to the soil that directly or indirectly impairs the health of animals and humans.
      4. Thermal pollution—caused by excessive heat in the environment which raises the earth's temperature.

MATERIALS FOR STUDENTS

- Vocabulary worksheet
- Newspapers and magazines
- Drawing paper, pencil, pen, etc.

- Notebook (preferably a 3-ring binder)
- Handsaw, plane, and chisel
- Samples of softwoods, hardwoods, plywood, particles board, and hardboard

SUGGESTED STUDENT ACTIVITIES

1. Begin a Woodworking Notebook. Include news clippings from the daily newspaper and/or magazines that relate to the woodworking industry. This activity should be an ongoing activity throughout the course. Include a vocabulary/key word section.
2. Begin a class woodworking bulletin board. Have students maintain and change the items on the board.
3. Arrange a field trip, or show a film that explains automation.
4. Do a time study of how individuals at school pollute the environment.
5. List several manufacturing enterprises, possibly in your city/town.
6. List several articles in your home that were manufactured.
7. What is meant by interchangeability of parts?
8. Working in small groups, have the students select one of the following activities:
   A. Product analysis
      (1) Select a product.
      (2) Discuss how the product was made. Examine clues such as surface appearance, weight, thickness, etc.
      (3) List primary and secondary processes that may have been used.
      (4) List various types of machines that may have been used.
      (5) Prepare a written report.
      (6) Present your findings to the class.
   B. Manufacturing devices research
      (1) Select a current manufacturing device (ECM, EBM, EDM).
      (2) Research how the device was developed, how it is being used, and how it works.
      (3) Prepare a written report.
      (4) Present your findings to the class.
   C. Flexible control devices research
      (1) Select a current flexible control device.
      (2) Research how the device was developed.
      (3) Prepare a written report.
      (4) Present your findings to the class.
   D. Recycling research
      (1) Select a common metal such as iron, gold, copper, etc.
      (2) Research how the metal is currently being recycled.
      (3) Prepare a written report.
      (4) Present your findings to the class.
9. List several reasons why studying manufacturing could be of value to you.
10. List several reasons why studying woodworking could be of value to you.
11. Locate examples of part manufacturing, subassembly manufacturing, and product manufacturing.
12. Using plastics, woods, and metals, list examples of standard stock.
13. Set up the manufacturing of a simple product for students to make. Prepare all jigs, fixtures, and standard stock prior to activity.
14. Have students try to work with conventional hand tools on hardwoods, softwoods, plywood, particle board, and hardboard. Record results.
15. Have a spelling bee using the vocabulary words. Students can add to the vocabulary list from their outside reading.
16. Explain why intermittent manufacturing lends itself to a school laboratory environment.

Vocabulary Worksheet

1. production technology
2. primary manufacturing processes
3. custom manufacturing
4. intermittent manufacturing
5. computer numerical control
6. prototype
7. ultrasonic cutting
8. tracers
9. electrical discharge machining
10. pollution
11. manufacturing
12. secondary manufacturing processes
13. continuous manufacturing
14. numerical control
15. adaptive control
16. electrochemical machining
17. laser micromachining

18. electron beam machining

19. robotics

20. recycling

TEST

Unit 1: Introduction to Manufacturing

Directions: Read each statement carefully. Select the one word, or phrase, that correctly answers or completes the statement. Write the appropriate letter in the blank.

Example: D 21. The class you are in is—
A. Science
B. English
C. Art
D. Industrial Technology

___ 1. Production technology includes the study of—
A. energy/power and construction
B. construction and manufacturing
C. manufacturing and visual communications
D. visual communications and energy/power

___ 2. Production technology involves the study of—
A. ceramics, leather, plastics
B. plastics, wood, leather
C. plastics, metal, wood
D. ceramics, wood, metal

___ 3. A factory-based, profit-making organization is a definition for a(n)—
A. manufacturing enterprise
B. construction company
C. production corporation
D. industrial activity

___ 4. The type of manufacturing that produces basic components for a product is—
A. subassembly manufacturing
B. primary manufacturing
C. part manufacturing
D. product manufacturing

___ 5. The joining of two or more parts and/or subassemblies to produce a completed product is—
A. subassembly manufacturing
B. primary manufacturing
C. part manufacturing
D. product manufacturing

___ 6. The joining of two or more parts to form a portion of a product is—
A. subassembly manufacturing
B. primary manufacturing
C. part manufacturing
D. product manufacturing

___ 7. Activities that convert raw materials into industrial materials are part of—
A. subassembly manufacturing
B. primary manufacturing
C. product manufacturing
D. secondary manufacturing

___ 8. Activities that convert standard stock into consumable products are part of—
A. subassembly manufacturing
B. primary manufacturing
C. product manufacturing
D. secondary manufacturing

___ 9. Cutting machines use this to produce copies of parts—
A. electrochemical machining
B. electrical discharge machining
C. tracers
D. laser micromachining

___ 10. This manufacturing device bombards the workpiece with abrasives—
A. laser micromachining
B. ultrasonic cutting
C. electron beam machining
D. ultrasonic cutting

___ 11. The device that cuts by alternately heating and cooling the area to be cut is:
A. electronic beam machining
B. tracers
C. ultrasonic cutting
D. electrical discharge machining

___ 12. The device that removes small particles with an electric arc is—
A. electron beam machining
B. electrical discharge machining
C. electrochemical machining
D. tracers

___ 13. Welding, spray painting, die casting, and heat treating are current jobs being replaced by—
A. CNC
B. lasers
C. robots
D. tracers

___ 14. The oldest type of manufacturing is—
A. continuous manufacturing
B. intermittent manufacturing
C. primary manufacturing
D. custom manufacturing

___ 15. The type of manufacturing that employs conveyors, elevators, and so forth is—
A. continuous manufacturing
B. intermittent manufacturing
C. primary manufacturing
D. custom manufacturing

___ 16. Grouping machines according to process is—
A. continuous manufacturing
B. intermittent manufacturing
C. primary manufacturing
D. custom manufacturing

___ 17. Flexible control devices are a direct result of the use of—
A. continuous manufacturing
B. intermittent manufacturing
C. primary manufacturing
D. custom manufacturing

___ 18. This type of manufacturing is seldom used to produce consumer products—
A. continuous manufacturing
B. intermittent manufacturing
C. primary manufacturing
D. custom manufacturing

___ 19. When large numbers of identical products are needed, this type of manufacturing is used—
A. continuous manufacturing
B. intermittent manufacturing
C. primary manufacturing
D. custom manufacturing

___ 20. The type of manufacturing used mainly in producing prototypes is—
A. continuous manufacturing
B. intermittent manufacturing
C. primary manufacturing
D. custom manufacturing

___ 21. When the volume is too low to support a single production line, use—
A. continuous manufacturing
B. intermittent manufacturing
C. primary manufacturing
D. custom manufacturing

___ 22. The constant uniform flow of parts is characteristic of—
A. continuous manufacturing
B. intermittent manufacturing
C. primary manufacturing
D. custom manufacturing

___ 23. Unusual, one-of-a-kind items are usually produced by—
A. continuous manufacturing
B. intermittent manufacturing
C. primary manufacturing
D. custom manufacturing

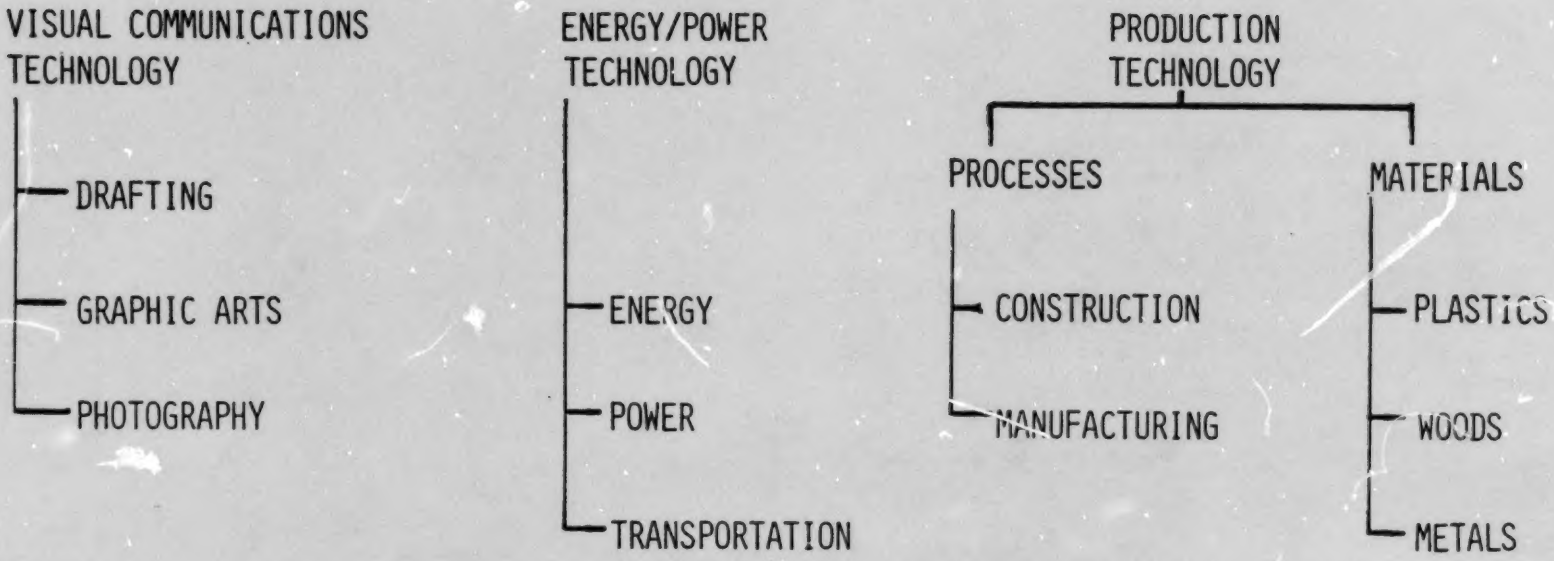
___ 24. Which type of manufacturing employs forklifts, tractors, cranes, etc.—
A. continuous manufacturing
B. intermittent manufacturing
C. primary manufacturing
D. custom manufacturing

___ 25. Which control device determines the optimum speed and feed during the actual machining and makes changes to improve the performance—
A. numerical control
B. flexible numerical control
C. adaptive control
D. computer numerical control

___ 26. The device that allows direct input at the machine location is—
A. numerical control
B. flexible numerical control
C. adaptive control
D. computer numerical control

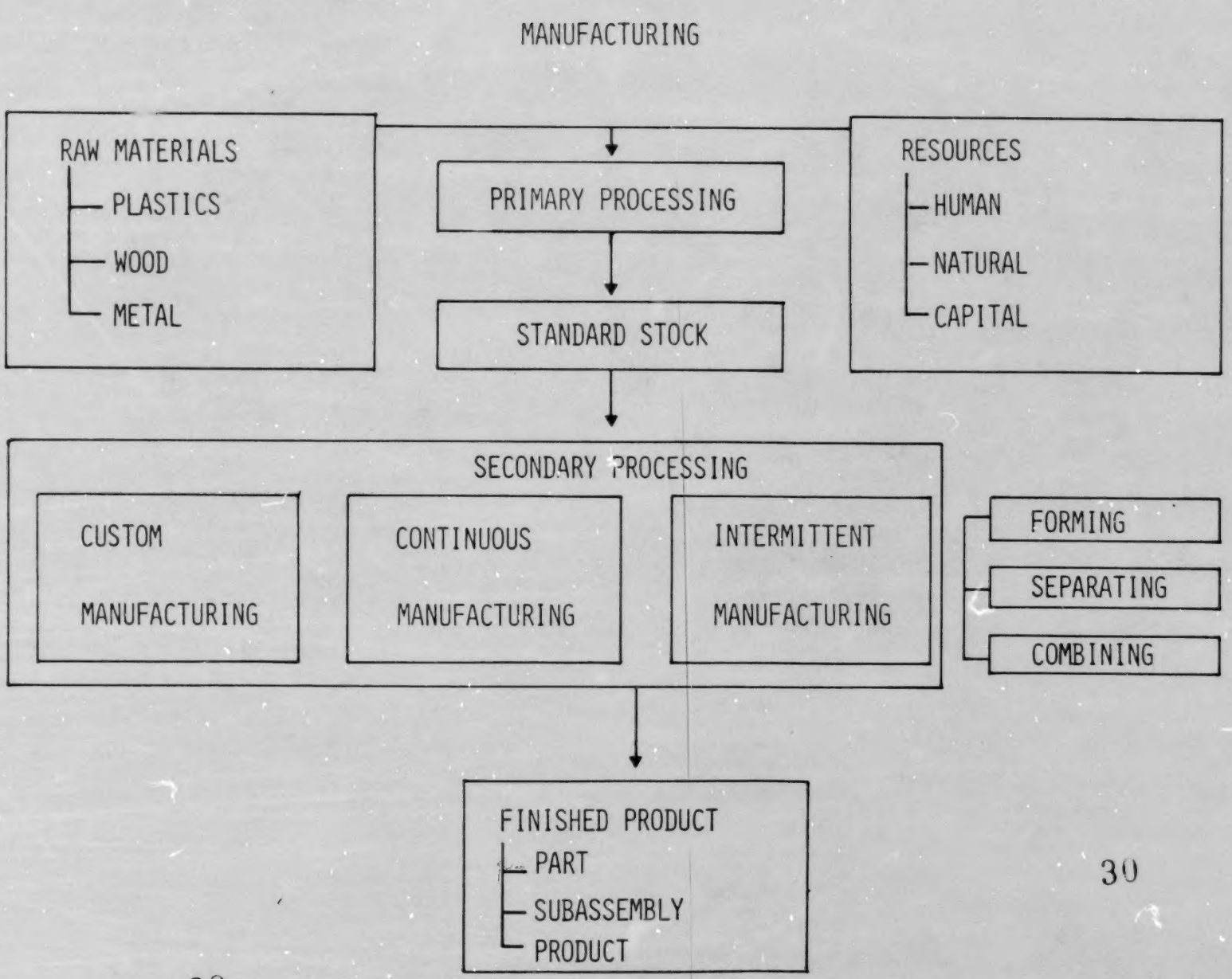
___ 27. Which device uses punch tape—
A. numerical control
B. flexible numerical control
C. adaptive control
D. computer numerical control

___ 28. The primary cause of pollution is—
A. automobiles
B. home heating
C. technology
D. airplanes


VISUAL COMMUNICATIONS TECHNOLOGY
DRAFTING
GRAPHIC ARTS
PHOTOGRAPHY
ENERGY/POWER TECHNOLOGY
ENERGY
POWER
TRANSPORTATION
PRODUCTION TECHNOLOGY
PROCESSES
CONSTRUCTION
MANUFACTURING
MATERIALS
PLASTICS
WOODS
METALS

INDUSTRY

MI-2


MANUFACTURING
RAW MATERIALS
PLASTICS
WOOD
METAL
PRIMARY PROCESSING
STANDARD STOCK
RESOURCES
HUMAN
NATURAL
CAPITAL
SECONDARY PROCESSING
CUSTOM MANUFACTURING
CONTINUOUS MANUFACTURING
INTERMITTENT MANUFACTURING
FORMING
SEPARATING
COMBINING
FINISHED PRODUCT
PART
SUBASSEMBLY
PRODUCT

MANUFACTURING PROCESSES

FORMING
- CASTING OR MOLDING
- COMPRESSING AND STRETCHING
- CONDITIONING

SEPARATING
- SHEARING
- CHIP REMOVING
- OTHER

COMBINING
- MIXING
- COATING
- BONDING
- MECHANICAL FASTENING

EXAMPLES OF METALWORKING PROCESSES

FORMING

- CASTING/MOLDING
  - SAND CASTING
  - DIE CASTING
- COMPRESSING/STRETCHING
  - BRAKE FORMING
  - ROLL FORMING
  - FORGING
  - DIE STAMPING
  - HIGH ENERGY RATE FORMING
  - SPINNING
- CONDITIONING
  - ANNEALING
  - TEMPERING
  - CASE HARDENING

EXAMPLES OF METALWORKING PROCESSES

SEPARATING

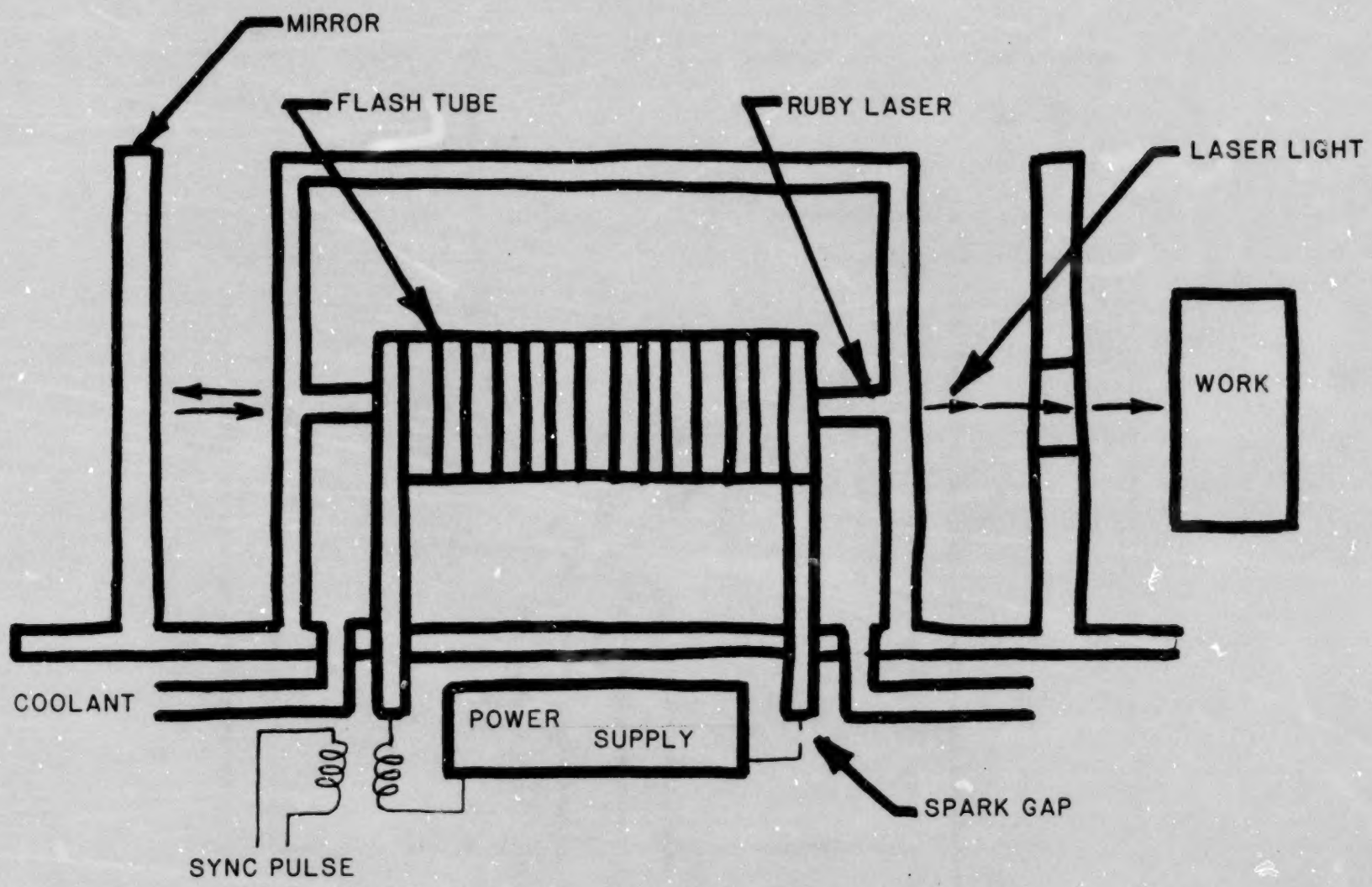
- SHEARING
  - SQUARING SHEAR
  - HOLE PUNCH
  - TIN SNIPS
  - NIBBLING
  - COLD CHISEL
- CHIP REMOVAL
  - FILING
  - TURNING
  - SHAPING
  - DRILLING
  - MILLING
  - GRINDING
- OTHER
  - ETCHING
  - OXY-ACETYLINE WELDING
  - ELECTRIC DISCHARGE MACHINING

EXAMPLES OF METALWORKING PROCESSES

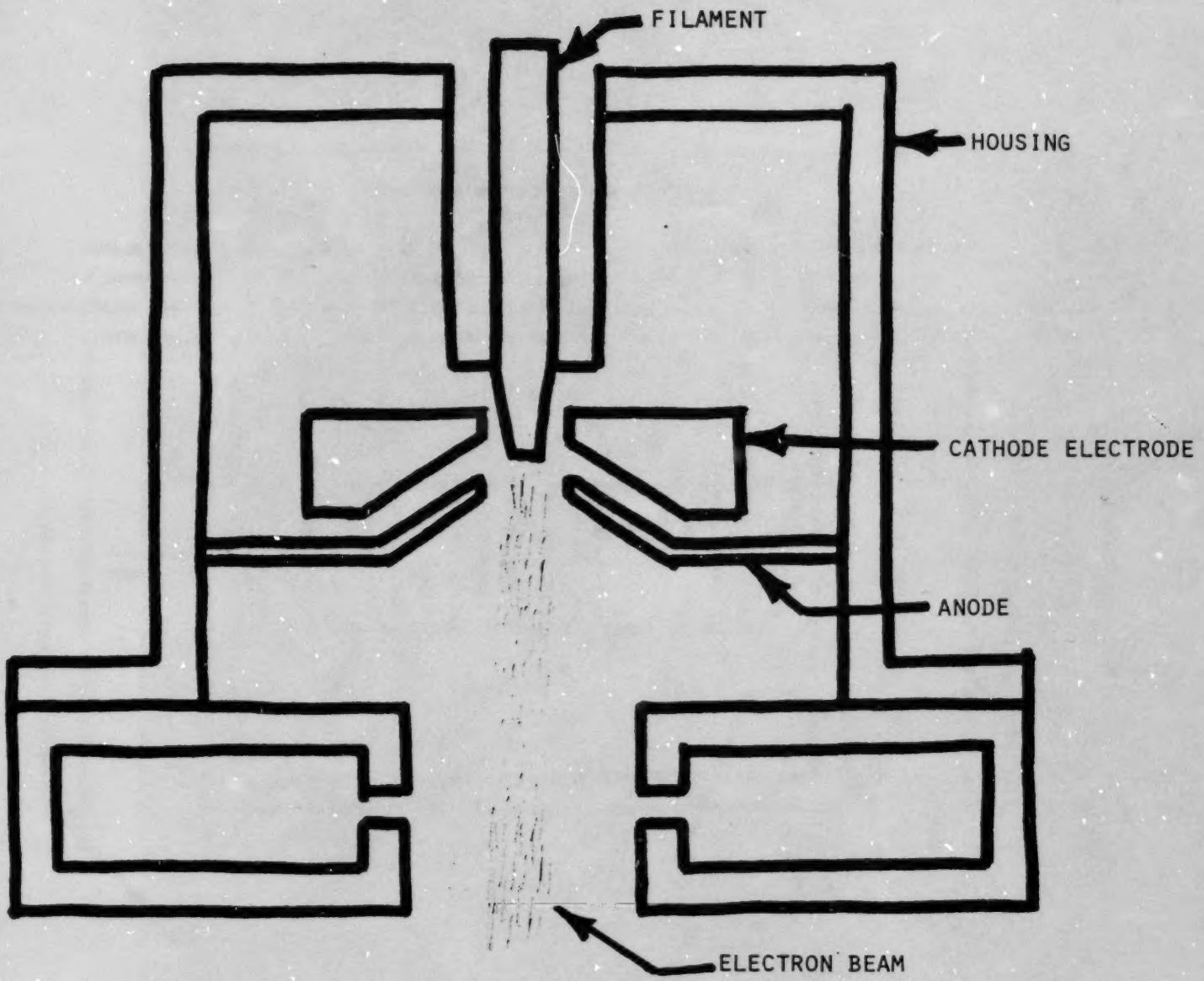
COMBINING

- MIXING
  - ALLOYING
- COATING
  - PAINTING
  - ANODIZING
  - PLATING
- BONDING
  - WELDING
  - BRAZING
  - SOLDERING
  - GLUING
- MECHANICAL FASTENING
  - RIVETING
  - TAPPING
  - THREADING

LASER MICROMACHINING

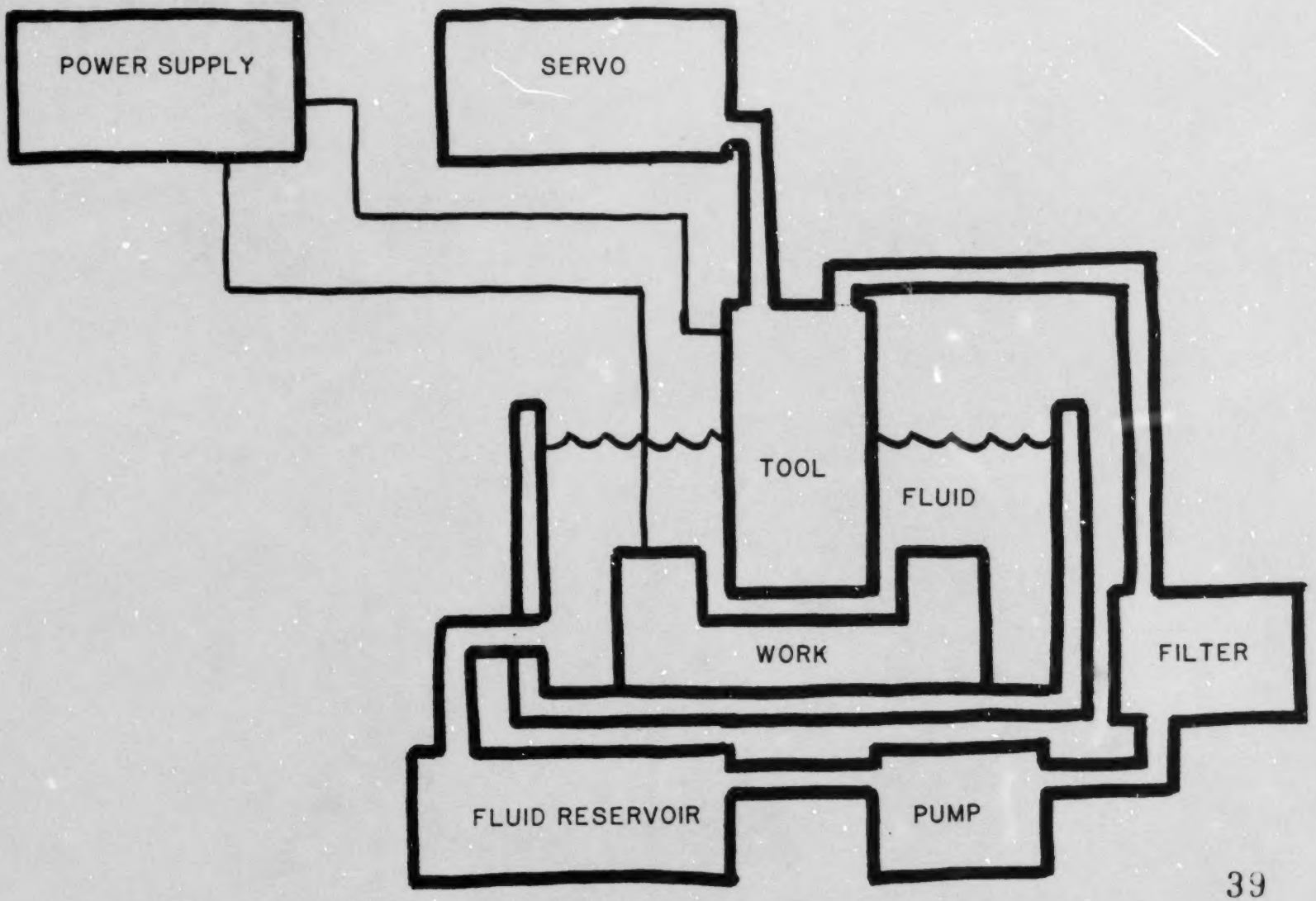


ML-7



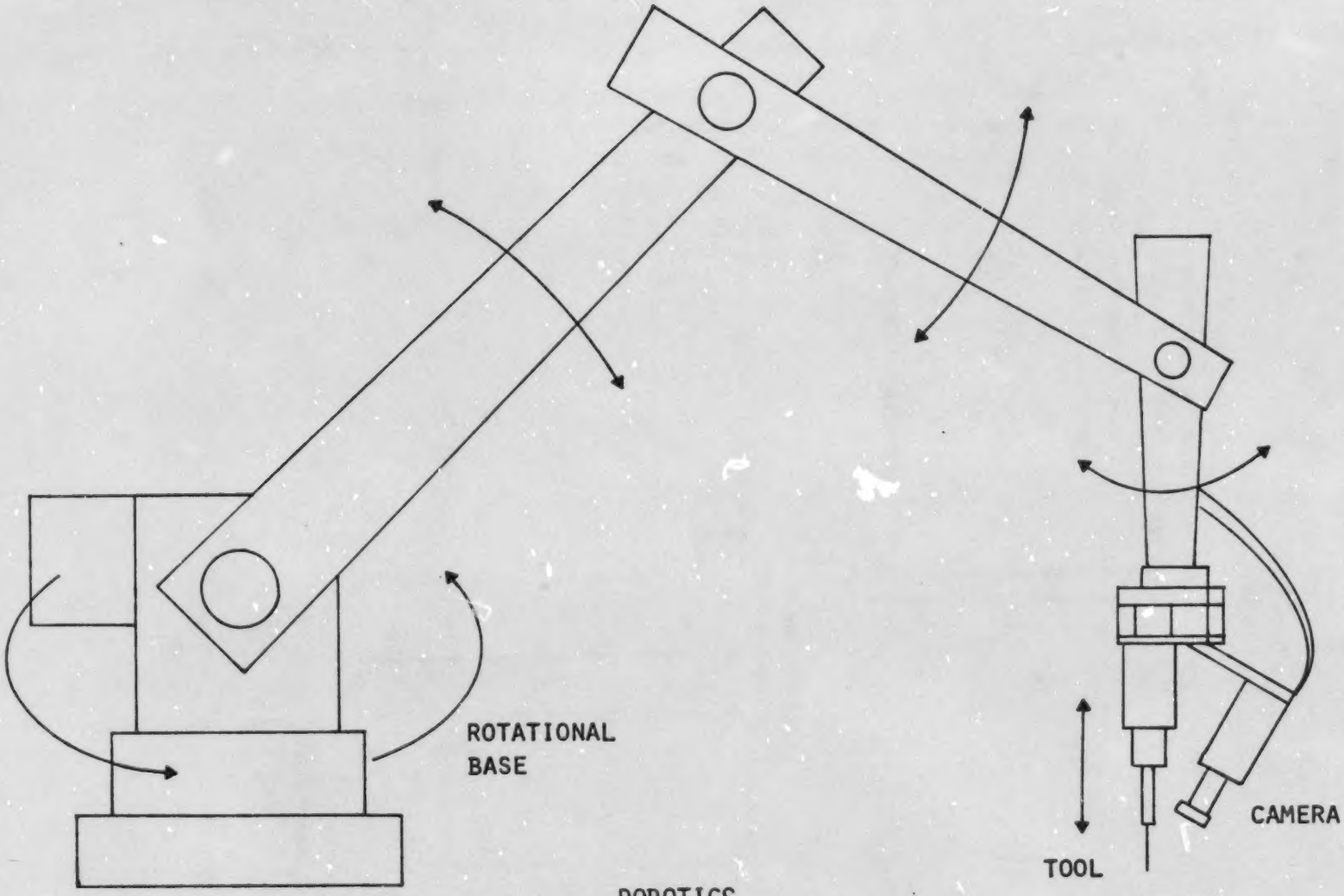
ELECTRON BEAM MACHINING

ELECTRICAL DISCHARGE MACHINING



MI-9

MI-10



ROBOTICS

Flow Process Chart

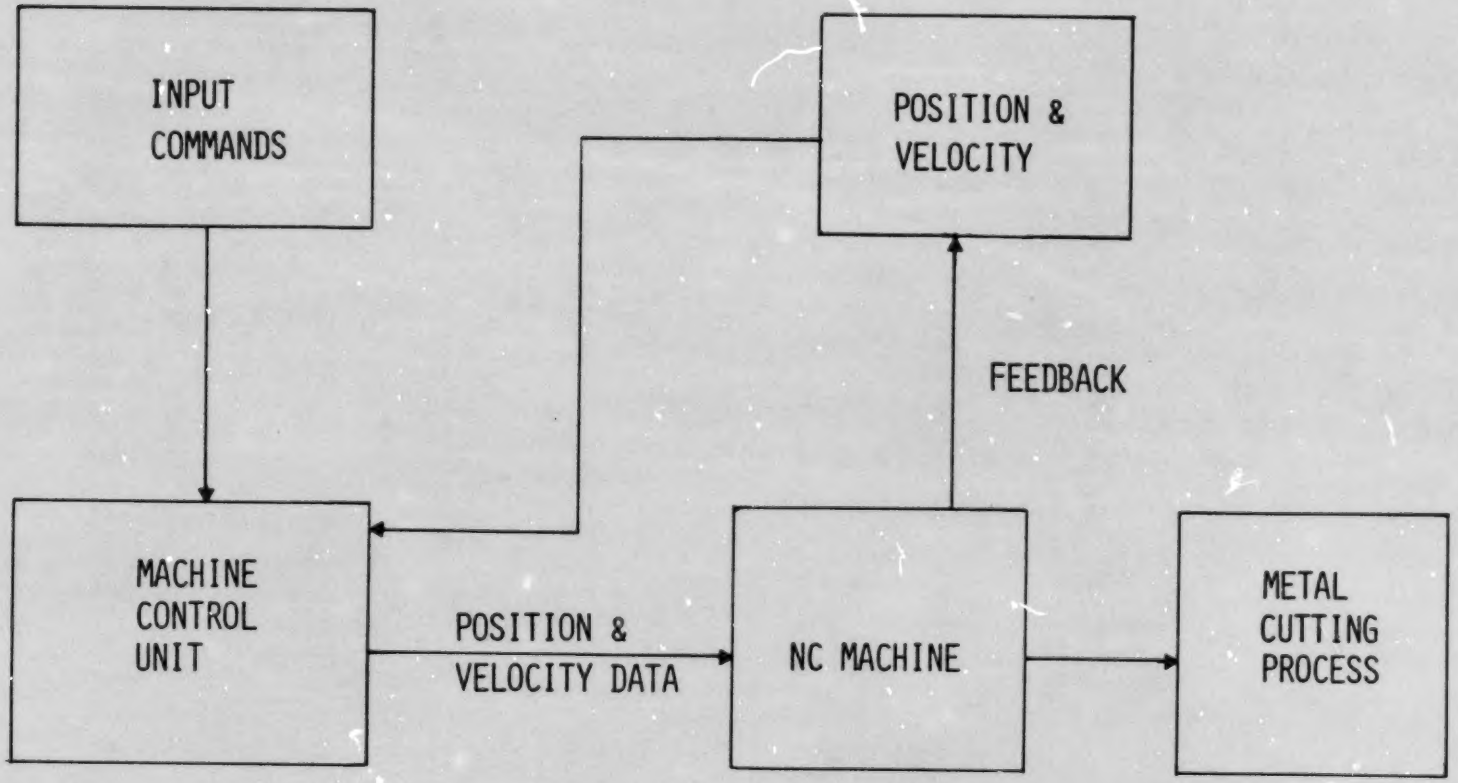
PRODUCT NAME	FLOW BEGINS	FLOW ENDS	DATE

PREPARED BY:	SECTION:	APPROVED BY:

PROCESS SYMBOLS & NUMBER USED	○ OPERATIONS___	□ INSPECTIONS___	⇨ TRANSPORTATIONS___
	D DELAYS___	▽ STORAGES___	

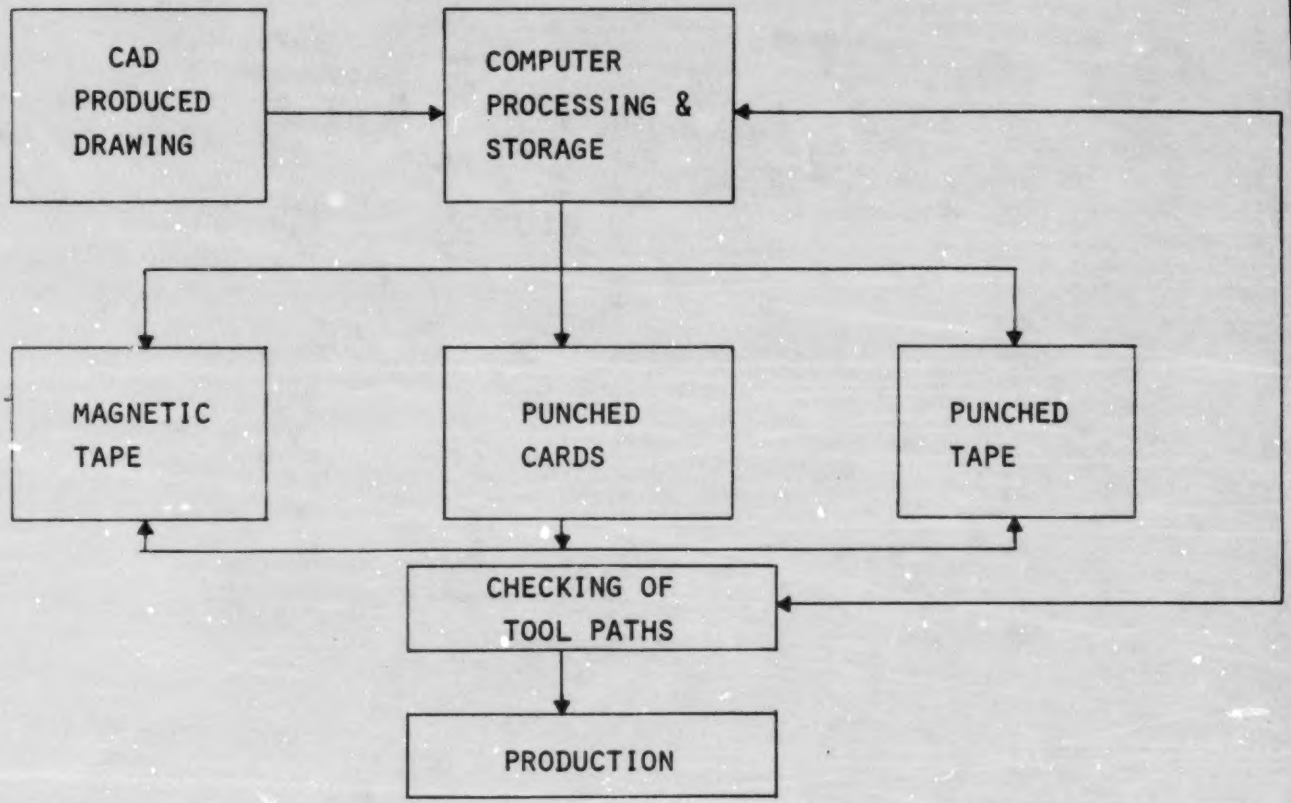
TASK NO	PROCESS SYMBOLS	DESCRIPTION OF TASK	MACHINE REQUIRED	TOOLING REQUIRED
	○⇨□D▽			
	○⇨□D▽			
	○⇨□D▽			
	○⇨□D▽			
	○⇨□D▽			
	○⇨□D▽			
	○⇨□D▽			
	○⇨□D▽			
	○⇨□D▽			
	○⇨□D▽			
	○⇨□D▽			
	○⇨□D▽			
	○⇨□D▽			
	○⇨□D▽			
	○⇨□D▽			

CONVENTIONAL NC SYSTEM

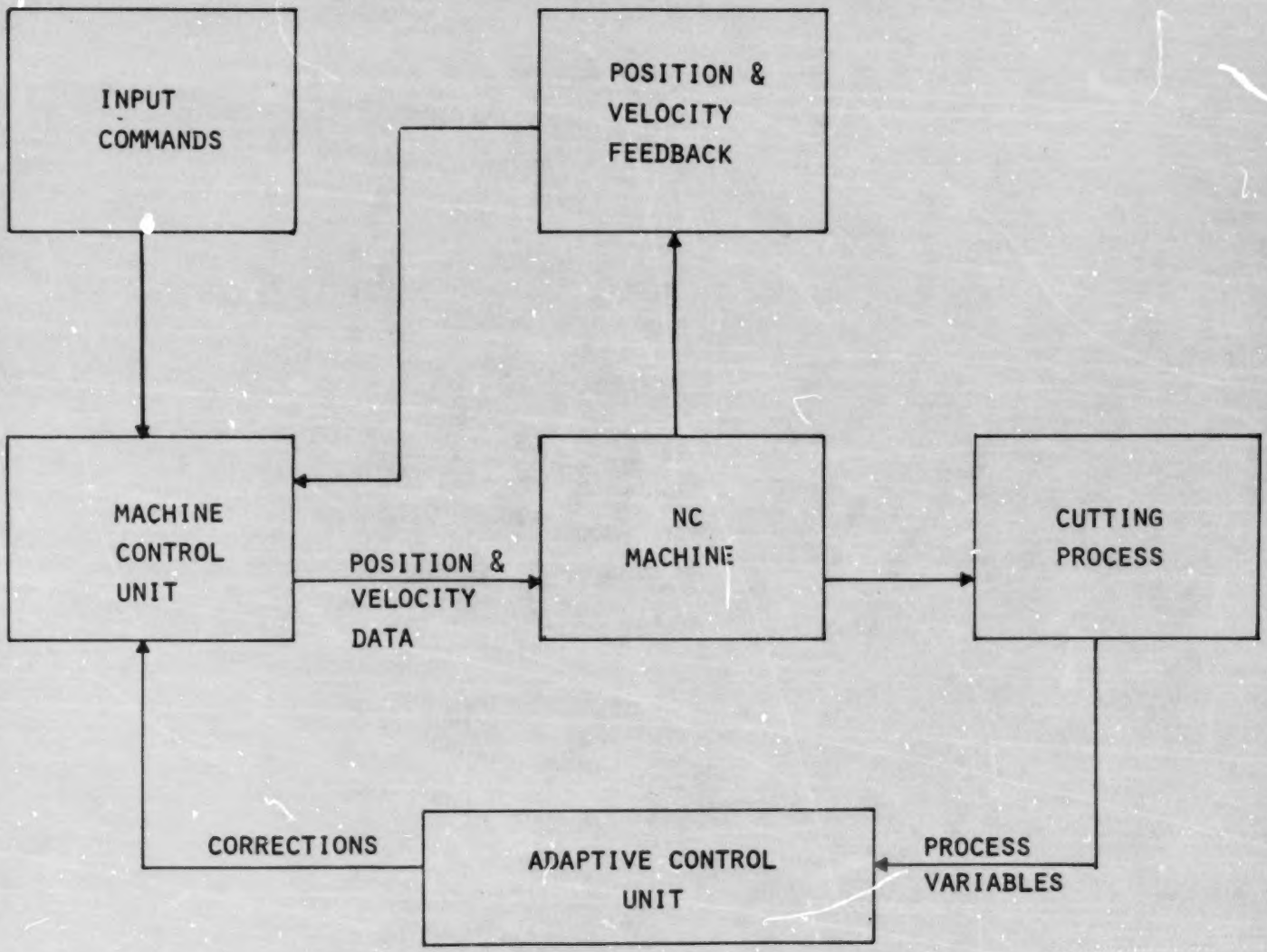


MI-12

COMPUTER NUMERIC CONTROL SYSTEM



ADAPTIVE CONTROL SYSTEM



Common Pollution Problems

Waste disposal sites

Polluted lakes, rivers, or streams

- loss of recreation
- odors
- loss of fish
- loss of business (fishing, recreation, etc.)

Air pollution

- automobiles
- industry
- agricultural burning

Culmination of rubbish

- disease
- flies, rats, etc.
- unsightly neighborhoods
- reduced property value

Increased noise pollution

- airports
- industry
- urbanization

2

Laboratory Management: Youth Leadership, Entrepreneurship, and Laboratory Organization

ORGANIZATION

This unit is divided into three separate sections, each dealing with a different aspect of laboratory management and the teaching of leadership skills. Section A deals with "Youth Leadership" and how these skills can be developed. "Entrepreneurship" covers material on the free enterprise system and how entrepreneurs (or risk takers) provide leadership in a capitalistic system. Section C, on "Laboratory Organization," provides a means of teaching leadership through the study of management. This section also explores the leadership qualities an employer looks for in an employee.

SECTION A: YOUTH LEADERSHIP

OBJECTIVES

After students have covered the material in this unit they should be able to—

1. participate in organizing a personnel system, conducting a meeting, and using democratic decision-making procedures;
2. list industrial and community resources, select at least three appropriate to the unit of study, and arrange for a speaker or tour;
3. conduct a survey of industries or use a questionnaire during interview with industrial career persons;
4. plan, organize, and carry out activities or projects which contribute to an improvement in, or service to, the school and/or community;
5. communicate with others to determine the need for products or services;
6. organize and manage their own business to produce a product or render a service of economic value that will have sales appeal to students or adults; and
7. organize, manage, and participate in contests, exhibits, or demonstrations that motivate students to learn and provide recognition for their achievements.

KEY WORDS: VOCABULARY

The words listed below may be new to the student studying woodworking. Teachers should help students understand these words as they are used in this topic of study.

personnel system
decision making
vendor
enterprise
organize
manage
technical
industrial and commercial resources

TEACHING AIDS

- Overhead projector
- Transparencies: You will find transparencies W2-1 through W2-12 at the end of this unit. If you wish, these masters may be duplicated in quantity and given as handouts to the students while they are studying different aspects of this unit.
  - W2-1: The Student Association as Personnel System with Uniform Titles
  - W2-2: AIASA Personnel In-Class Duties
  - W2-3: Committee Duties
  - W2-4: Organizational Structure

W2-5: In-Class Meeting Procedures
W2-6A&B: How Motions Are Made
W2-7: Duties for In-Class Use of Community Resources
W2-8: Duties for In-Class Service Products
W2-9: Duties for In-Class Enterprising Products
W2-10: Duties for In-Class Contests or Recognition
W2-11: Regional, State, and National Recognition Events for Industrial Arts Students
W2-12: Calendar of Activities

SUGGESTED REFERENCES

Achievement Program. Reston, Va.: American Industrial Arts Association, 1983.

AIASA Guide for Industrial Arts Program Standards for Industrial Arts Programs. Blacksburg, Va.: Virginia Polytechnic Institute and State University, November, 1981.

Barnes, James L. "American Industrial Arts Student Association Student Record Book." Unpublished research. Virginia Polytechnic Institute and State University, 1983.

Guide II: Student Association Activities in Industrial Arts Instruction. Richmond, Va.: Department of Education, 1979.

Texas Industrial Arts Student Association. Austin, Tex.: Texas Education Agency, 1975.

Texas Industrial Arts Student Association 1983 Handbook Regional and State Competition. Austin, Tex.: Texas Education Agency, 1983.

Willcox, George R. "AIASA: As a Teaching Tool." Paper presented at the meeting of the American Industrial Arts Association, Pittsburgh, Pa.: March 23, 1981.

SENTENCE OUTLINE

I. Using personnel/leadership development systems (Transparency W2-1)
   A. All organizations use systems to manage group activities.
   B. The personnel who hold various positions in the system rely on the total group working together for the benefit of all in the organization. (Transparency W2-2)
   C. The personnel system is made up of officers and committees which are responsible for carrying out the duties and responsibilities of the organization. (Transparencies W2-3, W2-4)
   D. It is important for students to work together and to develop leadership skills. (Transparency W2-5)
   E. Democratic decision making is developed through the process of conducting meetings and learning how to make motions in those meetings. (Transparency W2-6 A & B)

II. Using industrial community resources (Transparency W2-7)
   A. Making contacts with community and industrial leaders will help develop leadership skills.
   B. Part of leadership development is learning how to survey industry and to use a questionnaire during an interview.
   C. Community resources are an extension of the industrial arts classroom which allow students a more in-depth exposure to personnel/leadership development.

III. Providing a school or community service (Transparency W2-8)
   A. Service or community projects provide benefits to others and to those who provide them.
   B. Service projects enable students to use their technical know-how to help others in the same way that inventions help solve problems.

IV. Selling a product or service (Transparency W2-9)
   A. The industrial system in the United States is called free enterprise. This means that we are free to establish any kind of business we wish and to make almost any product we wish.
   B. Through free enterprise companies are encouraged to produce new products which are protected by patents.

C. Products are sold for their economic value and services are provided for their economic value.

V. Recognizing student achievements (Transparency W2-10)
   A. AIASA contests and booth exhibits provide opportunities for students to develop leadership skills through competing and interacting with other students on the regional, state, and national level. (Transparency W2-11)
   B. Through the various contests and exhibits students will be recognized for outstanding individual and chapter work. (Transparency W2-12)

MATERIALS FOR STUDENTS

- Vocabulary worksheet

SUGGESTED STUDENT ACTIVITIES

1. Have students participate in a discussion of the various positions in the Personnel/Leadership System. After election to an office or committee position, they will practice the duties. Their duties will help them conduct class meetings and manage laboratory activities. During class meetings the students will use parliamentary procedures to make democratic decisions. These experiences help all students learn how meetings are conducted by AIASA and other groups.
2. Have all students study the handouts describing the personnel system used in the class.
3. Form a nominating committee to work with teacher and prepare ballot.
4. Have students who are elected to office or committee positions study duties and learn how to conduct a meeting.
5. Encourage students to learn parliamentary procedures so that motions are used by all students.
6. Arrange for class officers to conduct a meeting to decide which industrial and community resources will be used to learn a certain unit of Industrial Arts. A community resources committee meets to list and select appropriate speakers or industrial tours. Have the class vote on the best resource. With help from the teacher and the principal, call or write the speaker. If all students are not permitted to visit the industry, the committee may visit, videotape the industry, and report to the class. Afterwards, a "thank you" letter should be written to the persons who assisted the class or committee.
7. **Class Officers:** Conduct a class meeting wherein your teacher gives a lesson on **Using Community Resources.** The historian serves on this committee. After the committee selects the appropriate resources, the officers conduct a meeting to select one. The officers should announce when the next class meeting will be held to allow time for this activity.
8. **Committee members:** (1) Use the library, chamber of commerce directories, or Yellow Pages to find an industry or business related to the unit of study. (2) After the class votes on the best resources, the committee writes a letter to invite the speaker or arrange a tour. (3) The parliamentarian obtains permission forms from the principal's office if required. (4) A follow-up is made to check on arrangements. (5) If the class is not permitted to visit the industry, the committee may visit and videotape the our for the class. (6) A "thank you" letter is written to the speaker or industry. (7) Records are kept in a file for use by other class or school chapters.
9. Have class officers conduct a class meeting to decide which service project will be provided by the class to help the school or community. A service committee will organize the project and involve class members in laboratory work to complete the project for delivery or pickup.
10. Have class officers conduct a meeting to decide which product or service will be of economic value to the class or AIASA. The class works as a group to form the enterprise. An enterprise committee organizes the technical and financial details for

the class members. The entire class works to make a profit for the class or to pay for AIASA dues or other activity.

11. Have class officers conduct a meeting to decide which contests will provide recognition to students who achieve. The recognition committee organizes contests, exhibits, or demonstrations for the class. Class members will compete with each other or work together on a recognition event such as an open house.

Vocabulary Worksheet

1. personnel system
2. decision making
3. vendor
4. enterprise
5. organize
6. manage
7. technical
8. industrial and commercial resources

Section B: Entrepreneurship

INTRODUCTION

Knowledge of the three basic economic systems is necessary to understand entrepreneurship, since it cannot exist under certain conditions. The three basic economic systems are communism, socialism, and capitalism. Communism and socialism are similar in that they both are highly centralized economic systems operating on an economic grand plan developed by a few government planners. The major difference between the two is that communists may advocate force or revolution in spreading their beliefs whereas socialists advocate peaceful means. Capitalism, which encourages the free enterprise system and entrepreneurship, lacks an overall grand economic plan. It is entrepreneurs such as individuals and companies that take risks on what products to produce, in hopes of making a profit. The consumer determines what products they will buy, which in turn determines what products will be produced.

OBJECTIVES

After students have covered the material in this unit, they should be able to—

1. describe the fundamental differences between the three major economic systems of communism, socialism, and capitalism;
2. list several ways that individuals and companies can invest capital to make more money;
3. Jescribe the free enterprise system as it relates to the industrial system in the United States;
4. describe an entrepreneur;
5. describe the guidelines for entrepreneurship; and
6. list three controls that regulate the free enterprise system.

KEY WORDS: VOCABULARY

The words listed below may be new to the student studying woodworking. Instructors should help students understand these words as they are used in this topic of study.

economy
communism
socialism
capitalism
capital
entrepreneurship
regulation
partnership
corporation
investment
profit
stocks
competition
free enterprise system
supply and demand
sole proprietorship
business plan
financial plan

TEACHING AID

Test Key: 1-C, 2-A, 3-B, 4-B, 5-D, 6-B, 7-A, 8-C, 9-C, 10-D

SUGGESTED REFERENCES

Fales, J.; Sheets, E.; Mervich, G.; Dinan, J. Manufacturing: A Basic Text For Industrial Arts. Bloomington, Ill.: McKnight Publishing Company, 1980.

Wright, T. R., and Jensen, J. R. Manufacturing Materials Processing, Management, Careers. South Holland, Ill.: Goodheart-Willcox, 1976.

SENTENCE OUTLINE

I. Introduction
   A. Three types of ownership
      1. Sole proprietorship is a single person owning a business.
      2. Partnership means several people owning a business together.
      3. A corporation exists when shares of stock are sold to individuals and these individuals act as one to operate the business.
   B. All companies are organized in a certain hierarchy with various li[illegible] and staff functions and responsibilities.
   C. Entrepreneurship involves the functions of planning, organizing, controlling, and directing workers and activities.
   D. Entrepreneurship involves the feasibility of providing a high quality product or service to the consumer at a fair price.
   E. Securing and training manufacturing workers for the business is a vital part of entrepreneurship.
   F. Scheduling workers and routing materials for the job is a major factor in the overall success of the business. Seeing that these are accomplished in a timely manner with good workmanship is another.

II. What is communism? (examples: Russia and China)
   A. This type of economic government is highly centralized with a small group of governmental leaders making major economic decisions for everyone.
   B. The government owns the means to production (land, raw materials, factories, stores, transportation, etc.).
   C. Communism and socialism are basically the same, except politically. Communism may favor revolution and force to spread its beliefs; socialism advocates peaceful political changes.
   D. Entrepreneurships cannot exist in a highly-centralized form of government where risk-taking is discouraged.

III. What is socialism? (examples: Sweden and Denmark)
   A. Socialism is similar to communism where the means of production are owned by the government and a small group of leaders determine what, when, and how much to produce.
   B. Advocates of socialism believe in incorporating their beliefs into society peacefully.
   C. Most socialist states are mixed, allowing capitalism to co-exist.
   D. Entrepreneurship can flourish in a mixed socialist and capitalist state, but cannot exist in a pure socialist country.

IV. What is capitalism? (examples: United States and Canada)
   A. Capitalism is an economic system which stresses private economic decision making. It operates without an overall economic grand plan which is common to the communism and socialist economic systems.
   B. Capitalism is based on capital, or the surplus money of a company or individual.
   C. Capital is invested by individuals or companies with the hope of making more money.
      1. An individual may invest capital in a bank that pays interest, or take more of a risk and invest it in stocks which provide capital to companies.
      2. A company may invest its capital in new machines and facilities to produce more, better, or new products in hopes of making a profit or more money from its capital.

V. Free enterprise and entrepreneurs
   A. The industrial system in the United States is known as a free enterprise system, and the individuals and companies are free to make nearly any product they wish.
   B. The free enterprise system encourages individuals and companies to become entrepreneurs.
   C. Entrepreneurs are risk takers who invest capital to produce products with the hope of making a profit.
   D. The free enterprise system is controlled by the laws of supply and demand, competition, and regulation.
      1. Supply and demand: when demand is high for a product, entrepreneurs are willing to invest capital to produce more of a product, but a high supply of a product discourages entrepreneurs from investing capital.
      2. Competition is also a characteristic of a free enterprise system. Competition allows for two or more companies to produce similar products and compete in the market place for the consumer's dollar. The company that produces the best product, at the lowest price, usually makes the most profit.
      3. Regulations are set by the government and private agencies to control product specifications. (Examples: The Environmental Protection Agency (EPA) requires car makers to control the pollutants they emit into the environment; or the Food and Drug Administration (FDA) requires that new medicines placed on the market be safe.)

VI. Becoming an entrepreneur
   A. An enterprise is any business that sells products or services, or both, and is owned, managed, and controlled by one or more persons.
   B. All enterprises carry basic risks.
      1. There are no guarantees of success.
      2. There are no guarantees of making a profit.
      3. There are no guarantees that investments will not be lost.
   C. Private enterprise in America is a privilege of our economic system.
   D. Our business system is made up mostly of small, privately-owned companies.
   E. Our marketing system and competition within the markets for products and services is the strength of America.
   F. Our system is efficient because competition forces individual owners to streamline, cut waste, improve products and services, and place the consumer or customer at the top of the economic pile.
   G. Entrepreneurship lets you decide your own destiny.
   H. The entrepreneur's key to success is how well you manage what you have, and how well you plan.
   I. Entrepreneurship provides challenge and personal satisfaction.
   J. Satisfaction is knowing that you provide a valuable service to customers and make their lives better.

VII. Dangers and pitfalls to avoid
   A. Owning and managing a business requires great personal sacrifice.
   B. Ownership requires serious responsibilities.

VIII. Guidelines for entrepreneurship
   A. Get the right kind of assistance.
      1. Seek literature, publications, periodicals, textbooks, and other resources that give advice and essential knowledge.
      2. Visit the Small Business Administration offices.
      3. Talk to a local banker.
      4. Gain practical experience by working in the kind of business you wish to operate.
   B. Prepare a plan.
      1. You need a business plan.
      2. You need a marketing plan.
      3. You need an operating (profit and loss) plan.

4. You need an organization and staff plan.
5. You need job descriptions and responsibilities assigned to functions.

C. Get the financial assistance you need before you start.
1. You need a good credit rating.
2. You must know what you want to do.
3. You must have a good plan.
4. You must demonstrate good management and financial responsibility.
5. There should be a good balance between personal assets and borrowing funds.

D. Get professional marketing assistance.
1. A competent commercial real estate agent can help you choose a good location, lease a building, buy an existing business, or perhaps develop a new business in a new location.
2. An expert accountant will help you plan your finances, maintain your records, set up the right kinds of ledgers and accounts, and help you with rates, equipment purchases, employee records, tax reporting, and business planning.
3. You need a competent attorney to help you plan the legal forms of ownership of your business, negotiate contracts and leases, get the right kinds of licenses and permits, and explain the types of liabilities you assume.
4. You need help of the local chamber of commerce or merchants association.
5. You need to join a professional trade association.

IX. Planning your business

A. Financial planning. The Bank of America suggests that an entrepreneur begin by asking four questions:
1. What do I need the money for?
2. How much money do I need?
3. How and when can I repay the money borrowed?
4. Can I afford to borrow money at this time?

B. Business planning. A good plan has seven parts:
1. description
2. market analysis
3. product and service description
4. sources of supply
5. marketing plan
6. management plan
7. financial forms

MATERIALS FOR STUDENTS

- Vocabulary worksheet
- Newspapers, magazines
- Notebook

SUGGESTED STUDENT ACTIVITIES

1. Select particular stocks from the newspaper and follow their activity for a month. Determine if a profit or loss has been made.
2. Research the three economic systems: communism, socialism, and capitalism.
3. Discuss the differences between communism, socialism, and capitalism.
4. Have class officers conduct a meeting to decide which product or service will be of economic value to the class or AIASA. Class should work as a group to form an enterprise. An enterprise committee will organize the technical and financial details for the class members. The entire class will work to make a profit for the class or to pay for AIASA dues or other activity.
5. Have students build a product of their choice. This product may fulfill a personal need, be for a family member, and be sold to someone in the community. Students should show a profit for their efforts. Compare this type of enterprise with that in Activity 4.

6. Have a real estate agent, an accountant, and a banker serve on a panel to discuss business and financial planning with the class. This should be done through an AIASA activity.

Vocabulary Worksheet

1. economy
2. communism
3. socialism
4. capitalism
5. capital
6. entrepreneurship
7. regulation
8. investment
9. profit
10. stocks
11. competition
12. free enterprise system
13. supply and demand
14. sole proprietorship
15. partnership
16. corporation
17. business plan
18. financial plan

TEST

Unit 2/Section B: Enterpreneurship

Directions: Read each statement carefully. Select the one word, or phrase, that correctly answers or completes the statement. Write the appropriate letter in the blank.

Example: __D__ 21. The class you are in is—
A. Science
B. English
C. Art
D. Industrial Technology

___ 1. What type of economy has an overall grand plan for what will be produced and owns the means of production?
A. capitalism
B. socialism
C. communism
D. all the above

___ 2. What economic system, due to its lack of government control, strongly encourages entrepreneurship?
A. capitalism
B. socialism
C. communism
D. all the above

___ 3. Capital is—
A. money needed for basic survival needs of food, shelter, or clothing
B. surplus money an individual or company can use to invest
C. money put in a savings account
D. money that is needed to live on

___ 4. An entrepreneur—
A. can do well in a communistic country
B. is a risk taker
C. both of the above
D. does not owe any money

___ 5. What controls determine what will be produced in a free enterprise system?
A. supply and demand
B. competition
C. government
D. all the above

___ 6. What is stock?
A. money put into a savings account
B. money invested in a company
C. money used to live on
D. money that is borrowed

___ 7. A sole proprietorship—
A. is a single person owning a business
B. is several people owning a business together
C. exists when shares of stock are sold to individuals and these individuals act as one to operate the business
D. none of the above

___ 8. A partnership—
A. is a single person owning a business
B. exists when shares of stock are sold to individuals and these individuals act as one to operate the business
C. is several people owning a business together
D. none of the above

___ 9. A corporation—
A. is a single person owning a business
B. is several people owning a business together
C. exists when shares of stock are sold to individuals and these individuals act as one to operate the business
D. issues no stock

___ 10. A business plan—
A. includes only a market analysis
B. includes only a product and service description
C. includes only a management plan
D. none of the above

Section C: Laboratory Organization

OBJECTIVES

After students have covered the material in this unit, they should be able to—

1. explain the importance of an efficient management organization in industry;
2. complete an application form for a position of employment; and
3. identify and display the qualities employers look for in employees.

VOCABULARY WORDS

The words listed below may be new to the students. Teachers should help students understand these words as they are used in this topic of study.

application form
interview
supervisor

TEACHING AIDS

- Overhead projector
- Transparencies: You will find transparencies W2-13 through W2-15 at the end of this unit. If you wish, these masters may be duplicated in quantity and given as handouts to the students while they are studying different aspects of this unit.
  - W2-13: Organizational System Industrial Corporation
  - W2-14: Organizational System I.A. Laboratory
  - W2-15: Qualities of Good Employees

MATERIALS FOR STUDENTS

- Application form for supervisor's position
- Sample application forms
- Interview schedule
- Paper, pencils, and pens

SUGGESTED REFERENCES

Brown, Robert D. Industrial Arts Laboratory Planning and Administration. New York: Bruce Publishing Company, 1969.

Chruden, Herbert J., and Sherman, Arthur W., Jr. Personnel Management. 5th ed. Dallas, Tex.: South-Western Publishing Company, 1976.

SENTENCE OUTLINE

I. Lab Management
   A. All successful industrial corporations operate within efficient organizational systems.
      1. A good organizational system is necessary to make sure all tasks are performed with minimal loss of time, money, and materials.
      2. Efficient organization increases productivity and profit.
   B. In larger corporations, authority and responsibility are delegated by the Board of Directors to the president, vice presidents, managers, and supervisors. (Transparency W2-13)
   C. Many management systems are used in industry with the line system being the most common.

D. Industrial Arts laboratories can also benefit from the use of an efficient management system. (Transparency W2-14)
E. The development of an efficient laboratory system involves:
   1. Determining all tasks to be performed on a regular schedule—daily, weekly, monthly, yearly, etc.
   2. Deciding who should perform the tasks—teacher, students, maintenance personnel, custodial staff, etc.
   3. Determining how many students are needed to perform each task quickly and efficiently.
   4. Developing a system for rotating the tasks from student to student periodically.
   5. Developing an incentive plan to stimulate the students to perform the assigned tasks quickly, efficiently, and as well as possible.
   6. Selecting reliable and qualified students to fill the positions of supervisor and assistant supervisor.
F. Most people work better if they know they will be rewarded for work well done.
G. Common rewards used in industry include:
   1. An increase in wages.
   2. A promotion to a position of higher authority.
   3. Bonus time off from duties.

II. Employee selection
A. Most industries use an employee selection process which includes:
   1. The completion of an application form.
   2. A personal interview with the prospective employee.
B. During an interview for a prospective position, an applicant can improve the chances for employment by:
   1. Being well dressed and well groomed.
   2. Being well prepared with intelligent questions about the responsibilities and duties associated with the position.
   3. Having knowledge about the company, its products, and its operation.
   4. Displaying the qualities employers look for such as self-confidence, ambition, courtesy toward others, willingness to assume responsibility, honesty, the ability to follow instructions, and the ability to work with people. (Transparency W2-15)

SUGGESTED STUDENT ACTIVITIES

1. Identify and discuss all the tasks in the laboratory that need to be performed on a regular basis—(daily, weekly, monthly, etc.), and can be done by students.
2. Complete an application form for the position of supervisor, including qualifications for the position and reasons for seeking the position.
3. Have the teacher interview you for the position of supervisor and attempt to convince the teacher that you are the most capable person to fill the position.
4. Construct a mock-up of a time clock or some other suitable system to facilitate the checking of roll at the beginning of lab and the completion of all assigned tasks at the end of lab.
5. Identify and discuss incentives or rewards to motivate you and your fellow students to complete your assigned tasks, such as having one group on vacation through each rotation, added vacation time as a bonus for work well done, promotions, etc.

Vocabulary Worksheet

1. application form
2. interview
3. supervisor

The Student Association as Personnel System with Uniform Titles

All Industrial Arts courses benefit from a personnel system used to manage the classroom or laboratory activities of students. Personnel management is a function of any organization whether it be a class of students, corporation of employees or an association of volunteers. Most Industrial Arts personnel systems differ as to the titles of each position in the system. Using AIASA related titles in the personnel system will both manage the class, as well as, give students experience with a group organization.

Officers in a democratic organization are best selected by the members of the group. Thus, the teacher may ask the class to nominate persons for election as key management officers. Teachers using any of the titles on the left are encouraged to utilize the uniform title in the right column.

Current Title	Should Have This Uniform Title
General Manager Lab Supervisor Superintendent Project Director	PRESIDENT
Manager's Assistant Assistant Supervisor Co-Director Production Manager	VICE PRESIDENT
Roll Keeper Recordkeeper Letterwriter	SECRETARY
Accountant Purchasing Agent Supply Clerk Bookkeeper	TREASURER
Safety Director Attorney or Lawyer Contract Officer Permission Coordinator Inspector	PARLIAMENTARIAN
Clean-up Supervisor	SERGEANT-AT-ARMS
Public Relations Director Advertising Agent Publicity Director	REPORTER
Education Director Final Report Writer Scrapbook Manager Librarian	HISTORIAN

AIASA PERSONNEL IN-CLASS DUTIES

PRESIDENT (Students Name)

1. Leader of personnel system.
2. Calls clean-up.
3. Conducts class meetings.
4. Receives ideas and reports from the class members.
5. Suggests any possible lab improvements gained through experience.
6. Responsible for the assignment or election of new personnel.

VICE PRESIDENT (STUDENTS NAME)

1. Familiar with duties of President.
2. Substitutes for President.
3. Assists President as second level manager.
4. Helps follow-up committee work.
5. Helps other officers if absent or behind.
6. Makes organizational chart for class.

SECRETARY

1. Takes roll, makes slip of those absent for teacher.
2. Keeps Minutes of class decisions for reading at next meeting.
3. Records list of officers and committee personnel.
4. Prepares agenda for seminar or class meetings.
5. Sends letters when necessary.

TREASURER

1. Collects routine fees or AIASA dues.
2. Checks names of students who pay and writes receipt.
3. Charge students for use of supplies.
4. Helps teacher order supplies.
5. Cleans supply room.
6. Reports progresses of supply payment or purchases at meetings.
7. Serves on Enterprising Committee of class.

PARLIAMENTARIAN

1. Is responsible for general safety procedures.
2. Posts safety posters and information.
3. Files safety test records.
4. Inventories first aid supplies and notifies instructor when additional supplies are needed.
5. Reports any injuries to the instructor.
6. Helps President with motions and rules of class.
7. Serves on School/Community Service Committee of class.

SERGEANT AT ARMS

1. Oversees all clean-up personnel.
2. Makes substitutions for absent clean-up personnel.
3. Improvises and receives ideas for improving clean-up.
4. Reports to President and teacher when clean-up is completed.
5. Prepares room for class meetings.
6. May serve as Quality Control or Union Steward.

REPORTER

1. Reports to class on the progress of activities.
2. Prepares bulletin board or displays related to class activities or school AIASA.
3. Writes articles or makes photos for school newspaper.
4. Welcomes visitors and explains classwork.
5. Cleans darkroom if available.
6. Advertises projects or services of class.
7. Serves on Recognition Committee of class.

HISTORIAN

1. Picks up homework or assignments for teacher.
2. Checks off work turned in by class members.
3. Assembles group reports.
4. Keeps notebooks, files or scrapbook up-to-date.
5. Cleans books and reference area of class during cloud
6. Photographs activities.
7. Serves on Industrial Resource Committee of class.

COMMITTEE DUTIES

LABORATORY MAINTENANCE/ CLEANUP COMMITTEE

1. Sgt. at arms and officers appoint or rotate personnel to each position.
2. All students in class have duties or either as leader or worker in one of these areas:
   (1) Supplies and reference materials
   (2) Tools, equipment and machines
   (3) Auxiliary Rooms
   (4) Others (determined by teacher)
3. Workers report completion of duties to chairperson, leader, or sgt. at arms.
4. President, Sgt. at arms or teacher dismisses class at proper time.

INDUSTRIAL/COMMUNITY RESOURCE COMMITTEE

1. Make list of industrial or community resources related to course.
2. With teacher, select 3 helpful to unit of study.
3. Report resources available at class meetings for vote.
4. Arrange speakers or visits for class.
5. Send thank you letters.

SCHOOL/COMMUNITY SERVICE COMMITTEE

1. Make list of classroom, school or community service projects related to course.
2. With teacher, select 3 related to technical unit of study.
3. Review requests from others for services.
4. Report possible projects at class meetings for vote.
5. Organize class for work to be done.
6. Deliver service to appropriate person or group.

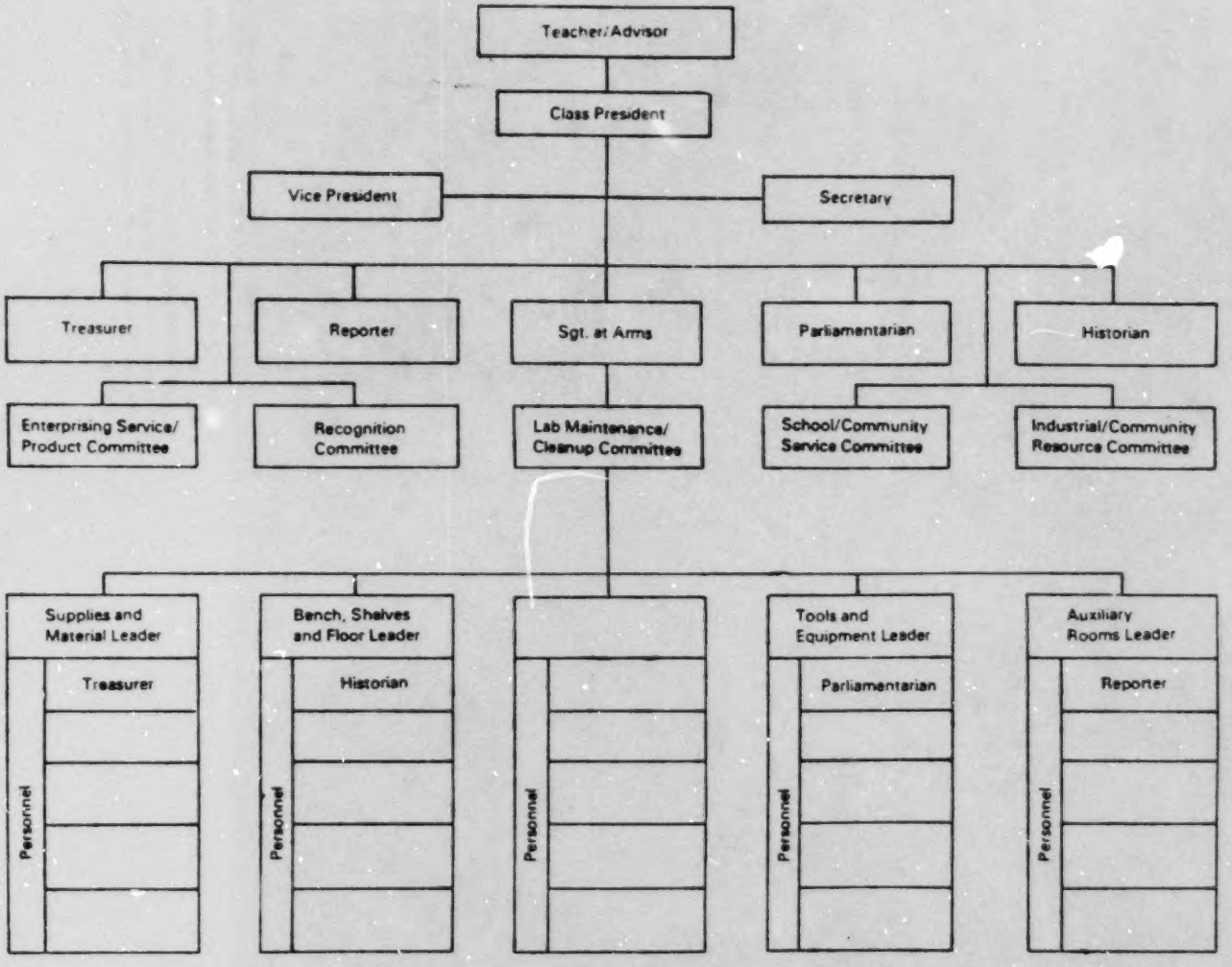
ENTERPRISING SERVICE OR PRODUCT COMMITTEE

1. Make list of products or services of economic value related to course.
2. Make prototypes of those related to unit of study.
3. Report possible products or services to class meetings for vote.
4. Organize company for production or service enterprise.
5. Keep financial records and report to class.
6. Present income for AIASA purpose to Treasurer.

RECOGNITION OF ACHIEVEMENT COMMITTEE

1. Make list of regular AIASA contests and others related to course.
2. With teacher, select or develop contests related to unit of study.
3. Report at class meetings on contests to be used.
4. Organize contest procedures and awards to be given.
5. Recognize winners with awards and newspaper articles.

ORGANIZATIONAL STRUCTURE



In-Class Meeting Procedures

Many of the routine activities of an industrial arts class can be handled by the officers of the class's student association. The **Class Meeting Agenda** should be in front of the students as poster to help each student understand meeting procedures.

1. Call to Order

President:	Raps gavel twice before saying - **Will the (class or meeting) please come to order? Sergeant At Arms, are there enough members present and in their seats to have a meeting?**
Sgt. at Arms:	**There are, (Mr. or Miss) President.** Tells students who arrive late to see Secretary for roll check.

2. Hear the Minutes of the Previous Meeting

President:	**We are ready to transact our business. Will the Secretary please read the Minutes?**
Secretary:	The Secretary stands and reads the Minutes which include date, time and place motions and other details of the last meeting.
President:	After the reading of the Minutes asks: **Are there any corrections or additions to the Minutes? (If none, the Minutes stand approved as read, or the Minutes stand approved as corrected.)**

3. Hear Reports of Officers or Standing Committees

President:	**The Assembly will hear reports of Officers.** (After each report, may ask; **You have heard the report. What is your pleasure?** For approval or adoption by motion?
Treasurer:	**The following amounts have been paid as (fees or dues) to the Treasurer $** _____. The amount of $_____ has been paid out. The total balance is $_____. The Treasurer may announce any fees to be paid or information about supplies.
Historian:	(May call for homework or assignments as part of group effort.)
Sgt. at Arms:	(May report on clean-up changes and condition of classroom and laboratories.)
Parliamentarian:	(May report or advise on procedures used for meeting or laboratory safety.)
Secretary:	(May report attendance information and give list of absent students to teacher.)
President:	**Do any Committees have reports?**
Maintenance Comm:	May report or advise.
Service Committee:	May report or advise.
Enterprising Comm:	May report or advise.
Resources Comm:	May report or advise.
Recognition Comm:	May report or advise.
President:	After each report say, **You have heard the report. What is your pleasure?**

4. Hear Reports of Special Committees

President:	**We will hear the report of the special committee for** _____.
Special Comm:	May report or advise.
President:	**You have heard the report. What is your pleasure?**

5. Hear Announcements

President:	**Are there any announcements to be made at this time?**
Reporter:	May report on class progress or outside events of interest to class or school AIASA.
Open to the Floor:	Other students may announce any meetings, activities or events scheduled in the future.
Teacher:	May wish to make announcements also.

6. Unfinished Business

President:	**The floor is open for discussion of unfinished business of the last meeting.**
Secretary or Parliamentarian:	May call attention to tabled motions or details from minutes of previous meetings.
Historian:	May remind members of homework or reports assigned or collect papers for teacher.

7. New Business

President:	**The floor is open for discussion of new business.**
Open to the Floor:	Suggestions for action not discussed before at the meeting would be introduced.
President:	(When the President feels that the discussion is complete, ask:) **Does anyone desire to make a motion?** (President acts on motion, appoints a committee or calls for another new business, or may call on the teacher (Mr., Miss, Mrs. _____, do we have a lesson?)
Teacher:	Presents lesson or announces laboratory work.

8. Adjournment of the Meeting

President:	Raps gavel twice. **If there is not further business, the meeting stands ready to adjourn.** Raps gavel 3 times. **What is our motto?**
All:	"Learning to Live in a Technical World."
President:	**Does anyone wish to introduce a motion to adjourn?** (Conduct vote on motion and declare adjournment) or say: Does anyone know of any reason why this assembly should not adjourn? **I declare this meeting adjourned.**

HOW MOTIONS ARE MADE

HOW TO PRESENT A MOTION

There are eight simple steps in presenting a main motion:

1. The member rises and addresses the President.
2. The member is recognized by the President.
3. The member states his idea as a motion.
4. Another member seconds the motion.
5. The motion is restated by the President.
6. The Presidents conducts the discussion.
7. The President puts the question to a vote.
8. The President announces the result.

The main motion forms the starting point for any action to be taken by the group. Informal discussion may be allowed in small groups, but to be considered, the motion must be made, seconded, and stated by the President.

The President should know the exact moment at which to stop any informal discussion. He may bring things to a head by saying:
"If definite action is sought in this matter, a motion is in order."

This is how a motion is made:

1. Stand and address the President: **"Mr. or Ms. President."** Wait until you are recognized by the President. Do not speak until you are recognized by a nod or by name.

2. Be sure you have your motion clearly in mind, and worded as briefly as possible. Write it out if you can.

3. When you have been recognized, state the motion so that all can hear: **"I move that this chapter give a rising vote of thanks to its sponsor, Mr. Gardner."**

4. After the motion has been made, another member, without waiting to be recognized, calls out: **"I second the motion."**

5. The motion having been made and seconded, the President states the motion by saying: **"It has been moved and seconded that this chapter give a rising vote of thanks to its sponsor, Mr. Gardner."**

6. When the chairman has stated the motion, it is said to be pending. It may now be considered by the group — that is, it is open to discussion and debate.

7. Any member may now rise to agree or disagree with the proposal. For example, a member may rise and say: **"Mr. or Ms. President."** The President says: **"Ron,"** so giving him permission to speak. **"I agree with the motion. Mr. Gardner has given his time to us and we should express our gratitude to him."**

8. The President inquires: **"Is there any further discussion?"** Since no one rises to discuss the motion further, the President asks, **"Are you ready for the question?"** (The "question" is the vote.) The members call out, **"Question?"**

9. The President then puts the question — that is, he takes the vote. He or she says: **"It has been moved and seconded that this chapter give a rising vote of thanks to its sponsor, Mr. Gardner. All those in favor of the motion say 'Aye.' "**
   The members in favor of the motion say, **"Aye."**
   The President then says: **"Those opposed, say 'No.' "**

10. The President then announces the vote: **"The Ayes have it. The motion is carried."** Or, **"The Noes have it. The motion is defeated."**

KINDS OF MOTIONS

There are four kinds of motions:

1. Privileged motion
2. Subsidiary motion
3. Incidental motion
4. Main motion

Motions that concern the rights and privileges of members are called privileged motions. Because of their urgency and importance they come before all other motions. The most common privileged motions are:

1. To fix time and place for adjournment.
2. To adjourn.
3. To take a recess.
4. Matters of personal privilege.
5. Orders of the day.

You will notice that four of these motions concern general rights. They are rights reserved to the chapter: when to adjourn, when to recess and when to insist that the rules be followed. The other motion, the motion of privilege, is the most important. It refers to a member's individual and personal rights.

Let us take an example of how this motion actually works.

Whenever there is any disturbance to the assembly, such as noise, presence of non-members, quarrels between members, or unpleasant atmospheric conditions, like excessive heat or cold, you may rise to a question of privilege. Suppose there is so much noise that you cannot hear. You might stand, and without waiting to be recognized, say: **"Mr. or Ms. President, I rise to a point of personal privilege."**

The President would then tell you to state your point of privilege. You might say, **"There is too much noise. I can't hear."**

Motions of personal privilege require no second, and are immediately decided by the President. In this case, he/she might direct the speaker to talk more loudly or he might take some other measure, such as closing the windows to shut out the disturbance. Business would then be resumed.

Subsidiary motions amend or otherwise dispose of other motions. There are seven of them. The two you may want to use, however, are (1) to refer to a committee, and (2) to amend.

You use the refer to a committee motion whenever you feel that the chapter should study the proposition more carefully before voting on it. You rise and say, **"Mr. or Miss President."**

When recognized, you then say: **"I move that this question be referred to a committee."**

This motion must be seconded. It can be amended. It can be debated. It cannot be reconsidered once the committee has begun its study. It requires a majority vote.

The motion to amend seeks to modify or change the motion under consideration. When you wish to make it, you must rise and say, **"Mr. or Ms. President."**

When you have been recognized by the President, you might say, **"I move to amend the motion by striking out the word 'annual.'"**

When you make this motion, you must be sure to state definitely the way in which you want the amendment made.

Motions that arise out of debate are called incidental motions. They are concerned with small matters that can readily be settled. For example, a member desires to know some matter of information (point of information) or a member desires to question a vote (divide the assembly), or a member desires to know if the proper procedure is being followed (point of order).

A main motion brings a new proposal before the chapter. It is only in order when no other main motion is being debated.

A main motion is subject to six conditions:

1. It must be seconded.
2. It can be amended.
3. It can be debated.
4. It can be reconsidered – that is, brought up a second time.
5. It can have additional motions that change it.
6. It requires a majority vote.

DUTIES FOR IN-CLASS USE OF COMMUNITY RESOURCES

This activity will help students learn how to invite and properly use a guest speaker in the Industrial Arts class. The particular content of the course or lesson will determine the type of resource person who should be contacted. The student learns to call, talk with, write letter, and introduce a speaker as part of classroom instruction.

Officer and Committee Duties

Community Resources Committee	This committee of the class meets often during the semester to find ways for industry and community resources to be used for the Industrial Arts class or laboratory. Types of resources include speakers, field trips and laboratory materials which help class with chosen activity. Teacher may suggest possible speakers related to technical or career aspects of the course.
President	Opens meeting to hear report of Community Resources Committee and involve class in deciding resources for class to use. Relatives, friends, industrial workers or business leaders may be suggested by class members. Class votes to use a resource in cooperation with teacher and school office.
Vice-president	May prepare sample questions for class members to ask speaker.
Secretary	Records suggested names of community resources and records any decisions made by class.
Treasurer	Most speakers will not require any financial assistance; however, if near lunch period the class may ask person to stay for lunch at school.
Parliamentarian	Helps class use proper procedures for inviting, talking to and thanking a resource speaker.
Reporter	Assures speaker will be met by committee or officer. Obtains information about speaker to announce to other teachers if appropriate.
Sgt. at Arms	Assures speaker is not interrupted while talking with class.
Historian	Records or videotapes speaker so speech can be saved for use with other classes.

TYPICAL SCHEDULE FOR USING A SPEAKER

Class Meeting 1.	Teacher explains that there are various resource persons in the community who could speak to the class and help them learn additional information.
2&3.	Students survey community for resources related to the topics of the course.
4.	Industrial/Community Resource Committee reports to class on those resource person they have considered good for the course content. Class officers conduct meeting of class to vote on one person to invite to speak.
5.	Committee writes letter to invite resource person giving dates suggested by teacher and with approval of principal's office.
6&7.	Committee prepares questions and gathers information related to speaker or the industry.
8.	Teacher follows up letter by calling the speaker to discuss dates, times, topic and school policies related to outside speakers.
Day of Speaker –	Committee meets speaker at arrival time and introduces speaker to principal, teacher and class. (Other teachers or classes may also attend.) Class members ask questions at appropriate time. Other committees or groups may seek advice on their activities or projects using the resource person as a consultant.
After speech	Reporter writes news story about speaker and talk. Thank you letter is written to speaker. Recordings of speech are shared with other classes or information is filed so that speaker can be invited again.

DUTIES FOR IN-CLASS SERVICE PROJECTS

This activity will use the procedures of the "Group Project" method which begins on Page 48 of the Exploring Technology Guide. This method uses "student involvement, interaction and skills to produce one or more tangible products ..." Leadership and followership are developed as students work together in the laboratory as one industry to produce a product.

Officer and Committee Duties

Service Committee:	Meets to screen or encourage and select a service project for the class to build.
President:	Opens meeting to hear report of Service Committee and involve class in decision. Class votes on service to be provided to another group.
Vice-president:	Reproduces organizational chart for group project system and asks class to determine who will take each position.
Secretary:	Keeps minutes of class meeting and records names of students who are members of group project.
Treasurer:	Advises class on financial details related to service project.
Parliamentarian:	Advises class on proper procedures for obtaining permission.
Sgt. at Arms:	May suggest services or improvements needed within laboratory such as tool holders or safety devices.
Reporter:	Writes story about plans of class to build a service project to help others. Takes photos of work and delivery for story.
Historian:	May share information on previous projects related to the one. Keeps records for other classes to use for reference.

TYPICAL SERVICE PROJECT SCHEDULE

Class Meeting 1.	Teacher explains group project method to class and students discuss possible service projects for Service Committee to consider.
2.	Service Committee reports to class a recommended service project and class selects project to build.
3.	Class Vice-President distributes organizational chart for Group Project and may have students apply for positions.
4.	Students report during seminar on role or duties they hold in Group Service Project. Research and Design Directors work to determine specifications and prepare drawings.
5.	Students apply for jobs in the organization.
6, 7 & 8.	Teacher may demonstrate technical areas related to project selected as needed in construction.
9.	Students use laboratory to build sub-parts of project.
10.	Reporting seminar permits students to present work completed or problems solved.
11.	Students use laboratory to assemble or complete project.
12.	Reporter and Historian write stories for public information.
13.	Teacher evaluates each student's participation as to technical knowledge gained and interest in helping others.

DUTIES FOR IN-CLASS ENTERPRISING PRODUCTS

This activity will use the procedures of the "Line Production" method which begins on page 49 of the **Exploring Technology Guide.** The method is used "to acquaint students with: the ways in which contemporary industry organizes people, materials, and machines into a common endeavor; the study of occupations related to areas of management and labor within industry . . ." The student learns to develop a company, solve management problems and realize profits from a salable product or service.

Officer and Committee Duties

Enterprising Committee:	This committee of the class meets separately to design or select products or services to enterprise for a profit. May use criteria for product selection, sketches or mockups. Organize sales training for all class members such as: Making sales presentations, taking orders and keeping records of sales contacts made, good manners and courteous behavior.
President:	Opens meeting to hear report of Enterprising Committee and involve class as Board of Directors in deciding what product to make and how profit will be used after product is sold.
Vice-President:	Reproduces an organizational chart of a company and sample personnel roles for distribution to students.
Secretary:	Records information decided by Board of Directors and result of voting for General Manager in the company.
Treasurer:	Helps determine financial needs of class and determine capital needed to begin production. Suggests recordkeeping system for enterprise.
Parliamentarian:	Prepares mock incorporation papers for the company and obtains approval from school officials with teacher.
Sgt. at Arms:	Assigns cleanup duties appropriate to production activity of class.
Historian:	Files records and samples of every phase of activity for other classes to use.
Reporter:	Selects or makes promotion materials to advertise product or service to school.

TYPICAL ENTERPRISING PRODUCT SCHEDULE

Class Meeting 1. Teacher explains line production method that class will use to raise funds for activity they select.

2. Enterprising Committee reports to class showing sketches or mockup models of products which could be produced and sold. Class votes on product and activity as the Board of Directors.
3. Vice-President distributes organizational chart for company. Class votes for person to lead as General Manager.
4. General Manager selects second line management and the Personnel Director to hire all other employees.
5. Design Engineer presents drawings to class and will prepare a very accurate prototype with the help of the production and industrial engineering departments.
6. Assess school for product sales appeal.
7. Each person will report on completed duties accomplished in the role held.
8. Personnel Manager will assign students to make necessary jigs and fixtures.
9. Assign students to work stations and try out a test run.
10. Production of products on assembly line.
11. Advertising personnel will design and produce posters and order forms for product sales.
12. Prepare a marketing management system to control products. Record who is contacted and sales information.
13. Deliver product to customer.
14. Account for all purchases, sales and losses.

DUTIES FOR IN-CLASS CONTESTS OR RECOGNITION

The activity will involve students in contests which are provided at local, regional, state and national conferences. Thus, students may practice and compete in tool identification, prepare an exhibit or give a speech as part of the way they are learning Industrial Arts. The teacher should suggest those contests to the Recognition Committee that relate to the course the students are taking.

Officer and Committee Duties

Recognition Committee:	This committee of the class meets to determine what contests relate to class and study rules for possible contests to be held in class or laboratory.
President:	Opens class meeting to hear report of Recognition Committee and involve students in selecting contest for class to use.
Vice-President:	Assists with organizational chart to show how students will compete.
Secretary:	Writes letters to persons who will be asked to serve as judges.
Treasurer:	Assists in determining and purchasing awards to be given to winners.
Parliamentarian:	May help select judges for contests and review rules for participation.
Sgt. at Arms:	May assist judges in keeping order or use of rules.
Reporter:	Writes up news stories about contests, exhibit or demonstration and announces winners. May invite community or other students to see contests.
Historian:	Keeps records of each activity and files records or photos for future reference.

DUTIES FOR IN CLASS OPEN HOUSE EXHIBITS

This activity will involve students in gaining recognition for their achievements in the industrial arts course. The officers of the class will assist with the activity and every student will not only help but will also contribute projects to be exhibited.

OFFICER AND COMMITTEE Duties

Recognition Committee:	This committee of the class meets to determine what type of Open House will be appropriate to the course and works with teacher to arrive at the best date.
President:	Opens class meeting to hear report of the Recognition Committee and involve class members in the decisions related to the Open House.
Vice-President:	Assists with the organizational procedures and work assignments of committee members and officers.
Secretary:	Writes letters or helps with invitations send to school personnel and others class wants to invite.
Treasurer:	Records expenses incurred during the Open House activity and seeks funds to meet these costs.
Parliamentarian:	Makes sure that proper procedures are followed as visitors are invited or other arrangements are made within the class or school.
Sgt. at Arms:	May assist committee in setting up exhibit tables and arranging for or cleaning up after open house.
Reporter:	Helps to publicize the Open House around the school. Takes photos and writes story before and after the event for the newspaper.
Historian:	Files and keeps information or photos of the event for use by future students.

SCHEDULES FOR RECOGNITION EVENTS

USING A CONTEST IN CLASS

1. Teacher presents idea and purpose of contest during class time.
2. Recognition Committee suggests possible contests for class to use.
3. Officers lead class meeting to decide of contest to be used.
4. Committee reviews or plans rules and organizes time schedule for individuals to compete.
5. Students practice during class or as homework.
6. Students or other judges select up to six finalists.
7. Finalists compete before judges and awards are presented to each.
8. Reporter and other officers carry out their duties.

ENTERING A CONTEST

1. Obtain and study contest guidelines or rule books.
2. Complete forms to pre-register in contest.
3. Mail forms to Spring Festival Contest Chairperson.
4. Prepare and practice for event in class, school and as homework.
5. Demonstrate to class and other school groups for judging or criticism.
6. Dress and conduct oneself appropriately for judging.
7. Appear at scheduled time for contest and awards program.

HOLDING AN OPEN HOUSE

1. Class decides if open house will be by class alone or request school AIASA to cooperate.
2. Obtain permission from school office date and place of open house.
3. Organize class members to help with various set-up details.
4. Announce to students how to enter projects for open house exhibit.
5. Send invitations to school personnel, parents and community resources.
6. Provide recognition for those who participate.

GIVING A TECHNICAL DEMONSTRATION

1. Select a technical topic which would interest or help other people.
2. Prepare research report or speech on the topic of demonstration.
3. Make models or assemble tools for demonstration.
4. Practice giving demonstration in class, school or as homework.
5. Arrange time and place to give demonstration such as State Fair, shopping mall or open house.
6. Dress and conduct oneself in professional way prior to and during demonstration.
7. Provide demonstration and answer questions of those who watched.

BEST COPY AVAILABLE

REGIONAL, STATE, AND NATIONAL RECOGNITION EVENTS FOR INDUSTRIAL ARTS STUDENTS

TECHNICAL PERFORMANCE CONTESTS

- Architectural Drawing
- Engineering Drawing
- Electricity/Electronics
- Graphic Arts
- L.S.R.A.V. (model race cars)
- Leathercraft
- Photography
- Metal Machining
- Small Engine Trouble Shooting
- Tool and Machine Identification
- Woodturning - between centers
- Woodturning - face plate
- Screen Process Printing (hand cut film)
- Metric 500 Race

GENERAL CONTESTS

- General Knowledge Test
- Public Speaking Contests (prepared and extemporaneous)
- Chapter Team Contest
- Research Paper Entry Contest
- Safety Poster Entry Contest
- Technical Writing Contest

- Booth or Display Contests
- Co-Curricular Activity Exhibit
- Community Service Project Exhibit
- Scrapbook or Record Book Exhibit
- Fund Raising Project Exhibit
- Booth Exhibit

PROJECT EXHIBIT CONTESTS (enter by course title and course code)

- Exploring Technology
- Modern Industry
- Construction
- Manufacturing
- Communications Technology
- Materials and Processes Technology
- Power and Transportation Technology
- Architectural Drawing
- Basic Technical Drawing
- Electricity and Electronics
- Energy and Power
- Engineering Drawing
- Graphic Communications
- Metals Technology
- Woods Technology
- General Industrial Arts
- Industrial Crafts

(for other titles see Spring Festival Permanent Rules)

CHECKLIST FOR CONTEST PARTICIPANTS

Directions: Performance and leadership contests are judged on the following aspects. To assist students to improve themselves for the contest these statements can be checked off by another person.

Technical Understanding

_____1. Accurate information used from books and research.
_____2. Impact or value of technology understood.
_____3. Safety procedures are used or described.
_____4. Information reviewed or approved by teacher.

Leadership

_____1. Leadership ability is exhibited.
_____2. Experienced as officer or participant in AIASA.
_____3. Voice and mannerisms are appropriate.
_____4. Assists with projects of class.
_____5. Helped prepare materials and forms for entry into contest.
_____6. Sent registration materials to contest chairperson.

Career Information

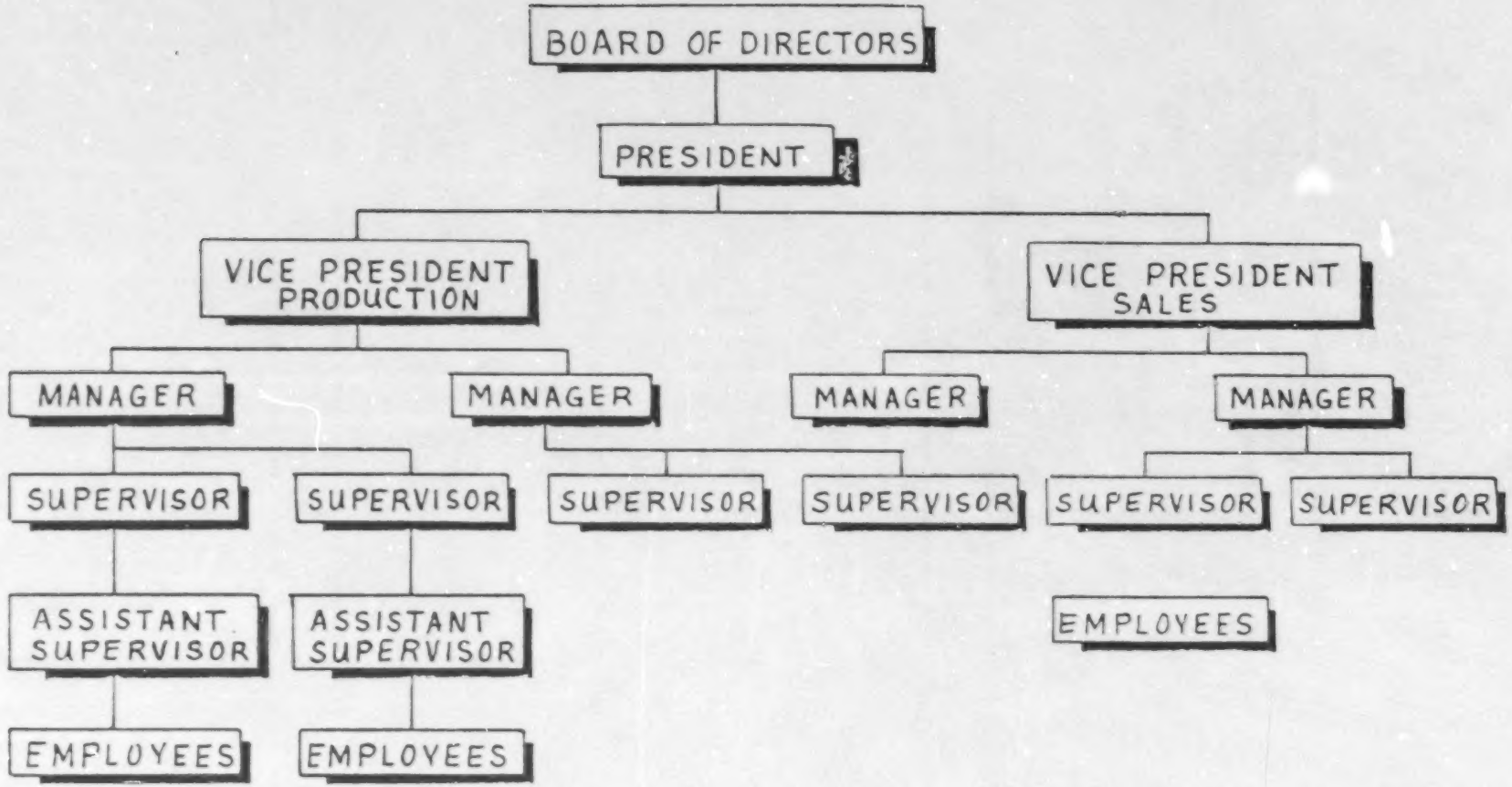
_____1. Knows at least 5 careers related to contest.
_____2. Understands requisites for career entry.
_____3. Lists programs for occupational preparation.

Performance

_____1. Shows interest and enthusiasm.
_____2. Dressed appropriate to contest.
_____3. Presents or demonstrates information in orderly manner.
_____4. Develops eye contact.
_____5. Voice and manner professional.
_____6. Paper organized well and holds interest.
_____7. Writing is accurate and to the point.

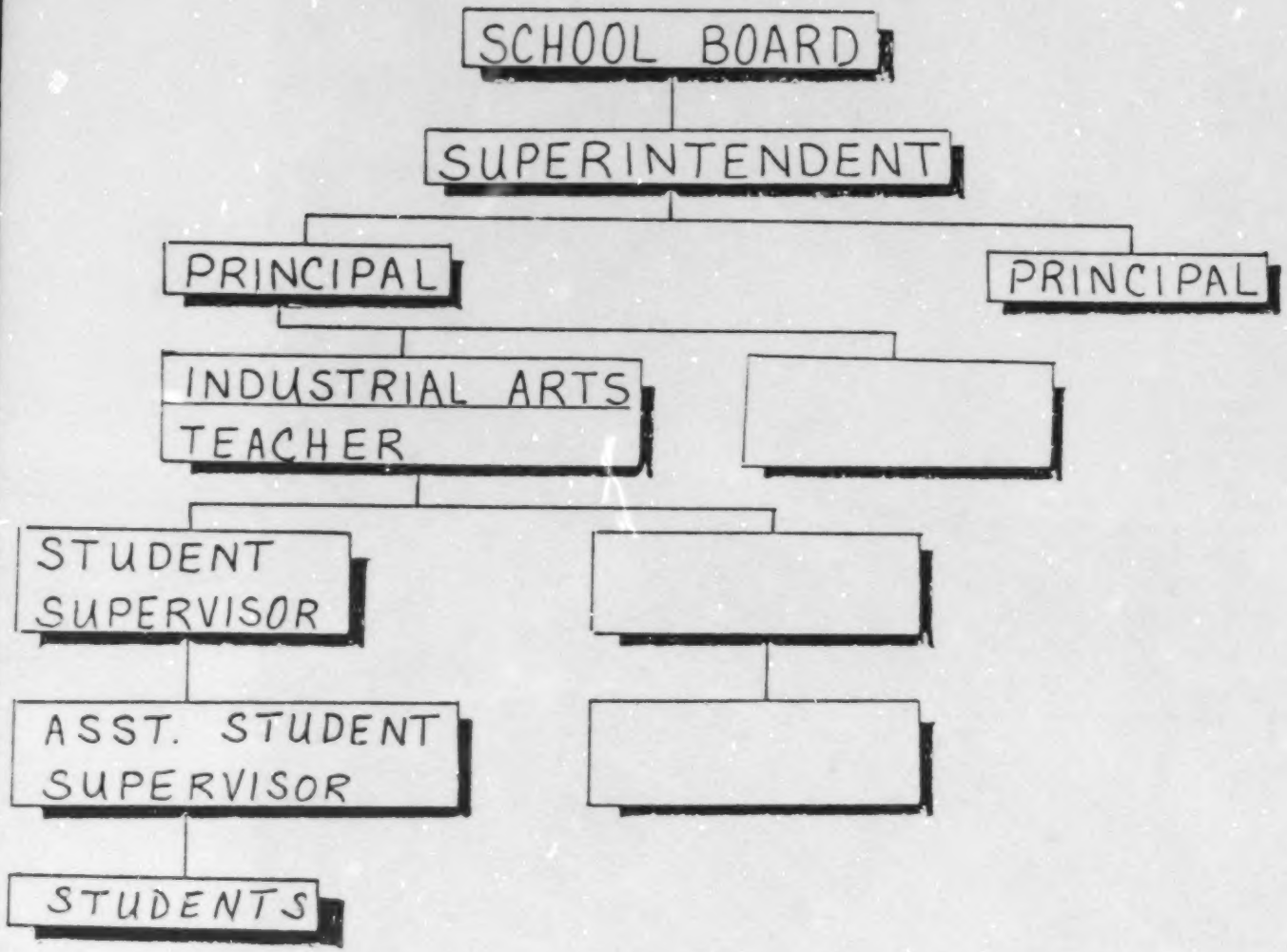
Calendar of Activities

August	September	October
November	**December**	**January**
February	**March**	**April**
May	**June**	**July**



M2-13

ORGANIZATIONAL SYSTEM
INDUSTRIAL CORPORATION

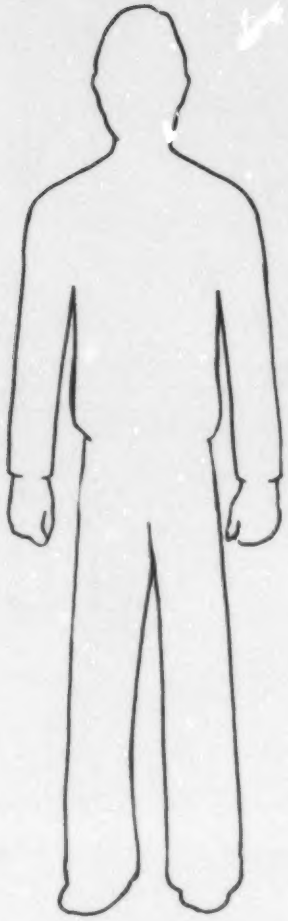


ORGANIZATIONAL SYSTEM
I. A. LABORATORY

QUALITIES OF GOOD EMPLOYEES

RESPONSIBILITY

WORKS WELL WITH PEOPLE



AMBITION

COURTESY

FOLLOWS INSTRUCTIONS

CONFIDENCE

HONESTY

3

Introduction to Wood as a Material

OBJECTIVES

After the students have covered the material in this unit, they should be able to—

1. identify the six major forest areas of the United States;
2. differentiate between softwoods and hardwood;
3. identify the three major parts of a tree;
4. identify the five major parts of a cross section of a tree's trunk;
5. differentiate between ring porous, semidiffused porous and diffused porous hardwoods;
6. describe how trees are harvested;
7. list the three methods used to saw trees into lumber;
8. describe the two methods used to dry lumber;
9. list the three grades of hardwoods and softwoods;
10. describe the common warps and defects associated with lumber;
11. describe how plywood is manufactured;
12. describe how particle board is manufactured; and
13. describe how hardboard is manufactured.

KEY WORDS: VOCABULARY

The words in the following list may be new to the students studying woodworking. Instructors should help students understand these words as they are used in this topic of study.

root
trunk
crown
outer bark
inner bark
cambium
sapwood
heartwood
annual ring
ring porous
semidiffused porous
diffused porous
flat-sawn
quarter-sawn
rift-sawn
air drying
kiln drying
first and second
select
common
board foot
yard lumber
structural lumber
factory or shop grade
linear foot
nominal size
actual size
plywood
particle or flake board
hardboard

TEACHING AIDS

- Overhead projector
- Examples of leaves, seeds, needles, and cones
- Cross section of a tree
- Examples of plain/flat-sawn, quarter-sawn and rift-sawn lumber
- Examples of rough-sawn and dimensional lumber
- Examples of common hardwoods and softwoods

- Examples of:
  1. plywood
  2. particle or flake board
  3. hardboard
- Test Key: 1-C, 2-B, 3-A, 4-C, 5-D, 6-A, 7-B
- Transparencies: You will find transparencies W3-1 through W3-10 at the end of this unit. If you wish, these masters may be duplicated in quantity and given as handouts to the students while they are studying different aspects of this unit.
  - W3-1: Areas of Forest Resources
  - W3-2: Hardwoods and Softwoods
  - W3-3: Major Parts of a Tree Trunk
  - W3-4: Pore Arrangement Per Annual Ring (Hardwoods)
  - W3-5: Types of Cuts
  - W3-6: Drying Lumber
  - W3-7: Types of Warp
  - W3-8: Plywood Manufacturing
  - W3-9: Hardboard and Particle Board Manufacturing
  - W3-10: Some Common Wood Defects

SUGGESTED REFERENCES

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Groneman, C.H., and Feirer, J.L. Getting Started in Woodworking. New York: McGraw-Hill, 1979.

Hammond, J.J.; Donnelly, E.T.; Harrod, W.F.; and Rayner, N.A. Woodworking Technology. Bloomington, Ill.: McKnight Publishing Company, 1980.

Hutchings, G.R.; Martin, G.E.; and Coleman, J.M. Working with Wood. Bloomington, Ill.: McKnight Publishing Company, 1982.

Miller, W.R., and Zook, W.H. Woodworking. Bloomington, Ill.: McKnight Publishing Company, 1978.

SENTENCE OUTLINE

I. What is wood?
   A. Wood is a natural material that comes from trees.
   B. Trees are the largest members of the plant family, and the redwood is the largest tree.
   C. A tree can be divided into three major components:
      1. Roots
      2. Trunk
      3. Crown

II. Forest regions of the United States
   A. Fifty percent of the U.S. land mass is covered by trees.
   B. There are six major forest areas (Transparency W3-1):
      1. The northern forest region produces one-fifth of the U.S. pulpwood and one-tenth of its lumber.
      2. The central forest region is the largest forest region in the U.S. Most of our hardwoods come from this region which produces one-twentieth of our lumber and one-tenth of our pulpwood.
      3. The southern forest region produces one-third of our lumber and three-fifths of our pulpwood.
      4. The western forest region produces one-fourth of our lumber.
      5. The west coast forest region produces one-third of our lumber and one-fifth of our pulpwood.
      6. The tropical forest is the smallest forest region in the U.S. and produces very little salable lumber or pulp.

III. The two major categories of wood are:
  A. Hardwood (Transparency W3-2)
    1. Hardwood trees have leaves and produce seed such as acorns (oak tree) or pecans (pecan tree).
    2. Hardwood trees have trunks that branch out toward the top of the tree. This leaves less of a trunk that can be used for lumber.
    3. Hardwood trees take longer to mature than softwood trees.
  B. Softwood (Transparency W3-2
    1. Softwood trees are identified by needles instead of leaves, like hardwoods are. Also, softwood seeds are usually contained within cones rather than being individual seeds.
    2. Softwoods have straight trunks with branches projecting from the trunk.

IV. Major parts of a tree trunk (Transparency W3-3)
  A. Outer bark is used to protect the tree fromm fire, disease, and insects.
  B. Inner bark is used to conduct food, minerals, and sap up and down the tree.
  C. Cambium generates new wood and bark cells. Three to five times as many wood cells are produced as bark cells.
  D. Sapwood contains newly formed wood cells and is used by the tree to store food.
  E. Heartwood is older wood which contains mineral and resin deposits.

V. Major parts of an annual ring
  A. Springwood comprises the largest portion of an annual ring and consists of large thin-walled cells.
  B. Summerwood consists of small thin-walled cells.
  C. Hardwood pore arrangement (Transparency W3-4)
    a. Ring porous - pores are large and they are arranged in a row around the annual ring (e.g. oak, ash).
    b. Semidiffused porous - pores are medium in size and are concentrated in the springwood with a few pores in the summerwood (e.g. walnut).
    c. Diffused porous - pores are very small and are distributed fairly evenly throughout the annual ring (e.g. maple, birch, cherry, poplar).
  D. Softwoods have no pores, and this fact can be used to distinguish hardwoods from softwoods.

VI. Harvesting lumber
  A. Lumber comes from trees and, like other plants, must be harvested before it can be used.
  B. Trees cut for lumber are harvested from forests that are privately owned or owned by the federal government.
  C. Trees may have to grow fifty to one hundred years before they can be harvested.
  D. The harvesting process:
    1. Loggers enter the forest and "fell" trees using chain saws.
    2. Loggers trim the trees of their branches.
    3. The logs are skidded out of the woods by power machinery.
    4. The logs are transported to the mill for processing.

VII. Sawing trees into lumber. Trees are commonly cut into lumber in three ways. (Transparency W3-5)
  A. Flat/plain-sawing is the most common method. Ninety percent of all lumber is cut this way. The lumber is cut tangent to the annual rings.
  B. Quarter-sawing is sawing a log into quarters and sawing the log perpendicular to its perimeter.
  C. Rift-sawing is quartering a log and sawing not less than 35^{o} nor more than 60^{o} to the annual rings.

VIII. Drying lumber

A. Drying lumber is extremely important. As lumber dries, its dimensions shrink. Therefore, it is important to have lumber dried properly before using it. (Transparency W3-6)

1. Air drying is accomplished by stacking lumber on the ground in a manner that allows air to freely circulate around the piece of lumber.
2. Kiln drying is accomplished by stacking lumber and placing it in a kiln. Temperature and humidity are controlled and the lumber is quickly dried.
3. Moisture content of lumber should be around 5-8% for indoor wood and 15% for outdoor wood.

IX. Grading lumber

A. The hardwood grading system is set by The National Hardwood Association.

1. First and seconds (FAS) is the highest grade for hardwood. This grade contains large, clear pieces of lumber.
2. Select is the second best grade.
3. Common is the third best grade.

B. Softwoods are harder to grade because grading standards are set by several lumber associations. Generally, softwoods can be classified under three different categories:

1. Yard lumber—general utility lumber one inch or less in thickness.
2. Structural lumber—lumber two inches or thicker used for supporting structural loads in building construction.
3. Factory or shop grade—highest grade of softwoods used for furniture and other applications needing high quality softwoods.

X. Ordering lumber

A. Hardwoods are commonly ordered by the board foot (abbr. bdft). A board foot is represented by a board one foot square by one inch thick.

B. Formulas for calculating board feet are:

1. $\frac{L" \times W" \times T"}{144}$
2. $\frac{L' \times W" \times T"}{12}$

3. Remember: When figuring board feet, a thickness less than one inch is considered to be one inch thick and anything over one inch in thickness is measured to the nearest quarter of an inch.
4. Hardwoods are also ordered by thickness.
   a. Common rough thicknesses are 4/4", 5/4", 6/4", and 8/4".
   b. Common surfaced thicknesses are 3/4" or 13/16".

C. Softwoods are usually bought milled and cut to length.

1. Softwoods are sold by the linear foot in standard dimensions. Lengths are commonly eight feet to twenty feet in two-foot increments.
2. Softwoods are ordered by nominal sizes such as 2" x 4" or 1" x 6"; the actual size is less, being 1 1/2" x 3 1/2" and 3/4" x 5 1/4" respectively.

XI. Lumber defects and warps

A. Defects (Transparency W3-10)

1. Knots are caused by a tree growing around a branch. Sound knots are caused when a tree grows around a live branch; loose knots are caused when a tree grows around a dead branch.
2. Splits are cracks in the end of a board caused by rapid drying of the end grain.
3. Wane is the presence of bark or the absence of wood.

B. Warp is the most common defect which occurs as wood dries. It is caused when differences in radial and annual ring shrinkage becomes too great. (Transparency W3-7)

1. Cup is the curvature of a board in its width.
2. Twist exists when a board twists like a propeller.

3. Bow exists when the face of the board is curved.
4. Crook occurs when the face of the board remains flat, but the edge of the board curves.

XII. Plywood is a manmade wood product that is made from veneer ply, a core material, and an adhesive. (Transparency W3-8)
   A. Veneer is wood that is sliced to a thickness under 1/4 inch.
   B. Veneer forms the front and back of a sheet of plywood. Plywood will always have an odd number of plys so the front and back will have the grain running in the same directions.
   C. The core (or center section) of plywood can consist of these common materials:
      1. Veneer
      2. Lumber
      3. Particle board/hardboard
   D. The adhesive used to hold plys together can be either water resistant for interior use or waterproof for outdoor use.
   E. Plywood comes in standard 4' x 8' sheets and has great resistance to shrinkage and warping. Plywood is also stronger than steel, pound for pound.

XIII. Particle or flake board is usually made from waste materials such as sawdust or planner chips. These wood particles are held together by an adhesive. (Transparency W3-10)
   A. Particle or flake board is very dense and heavy when compared to plywood.
   B. Particle or flake board is about one-third the cost of plywood and is often used to make low to medium priced case goods.
   C. Particle or flake board is sold in standard thicknesses and 4' x 8' sheets.

XIV. Hardboard is made from individual wood fibers obtained from low quality logs or wood waste materials. These wood fibers are held together by lignin which is a tree's own natural adhesive. The lignin is a by-product of paper making and is used to make hardboard. (Transparency W3-10)
   A. Hardboard commonly comes in thicknesses from 1/2" to 5/16" and in 4' x 8' sheets.
   B. Hardboard is cheaper than plywood and is often used for drawer bottoms and cabinet backs.

MATERIALS FOR STUDENTS

- Vocabulary worksheet
- Handouts
- Samples of common hardwoods and softwoods for students to identify
- Samples of plywood, particle board, and hardboard for students to identify
- Samples of flat/plain-sawn, quarter-sawn, and rift-sawn for students to identify

SUGGESTED STUDENT ACTIVITIES

1. Have students identify common hardwoods and softwoods based on:
   a. porosity (if a hardwood)
   b. color
   c. texture
   d. smell
   e. density
2. Have students identify major parts on a cross-section of a tree:
   a. heartwood
   b. sapwood
   c. cambium
   d. inner bark
   e. outer bark

3. Have students research the different uses for common hardwoods and softwoods.
4. Have students research the different forest regions of the United States as to their location and type of commercial wood harvested.
5. Have students research one of the following manufacturing processes involved in producing:
   a. lumber
   b. particle board
   c. hardboard
   d. plywood

Vocabulary Worksheet

1. root
2. trunk
3. crown
4. outer bark
5. inner bark
6. cambium
7. sapwood
8. heartwood
9. annual ring
10. ring porous
11. semidiffused porous
12. diffused porous
13. flat-sawn
14. quarter-sawn
15. rift-sawn
16. air drying
17. kiln drying
18. first and seconds

Vocabulary Worksheet

19. select

20. common

21. board foot

22. yard lumber

23. structural lumber

24. factory or shop grade

25. linear foot

26. nominal size

27. actual size

28. plywood

29. particle or flake board

30. hardboard

TEST

Unit 3: Introduction to Wood as a Material

Directions: Read each statement carefully. Select the one word, or phrase, that correctly answers or completes the statement. Write the appropriate letter in the blank.

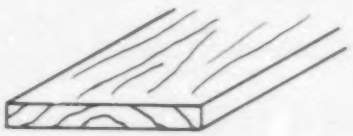
Example: D 21. The class you are in is—
A. Science
B. English
C. Art
D. Industrial Technology

___ 1. The part of a tree that is used for lumber is the—
A. crown
B. root
C. trunk
D. bark

___ 2. Which part of a tree is responsible for new bark and wood growth?
A. bark
B. cambium
C. sapwood
D. heartwood

___ 3. A hardwood, such as oak, which has large pores in a row around the annual ring is—
A. ring porous
B. diffused porous
C. semidiffused porous
D. semiporous

___ 4. The illustration represents lumber that was—
A. quarter-sawn
B. rift-sawn
C. flat/plain-sawn
D. hand-sawn

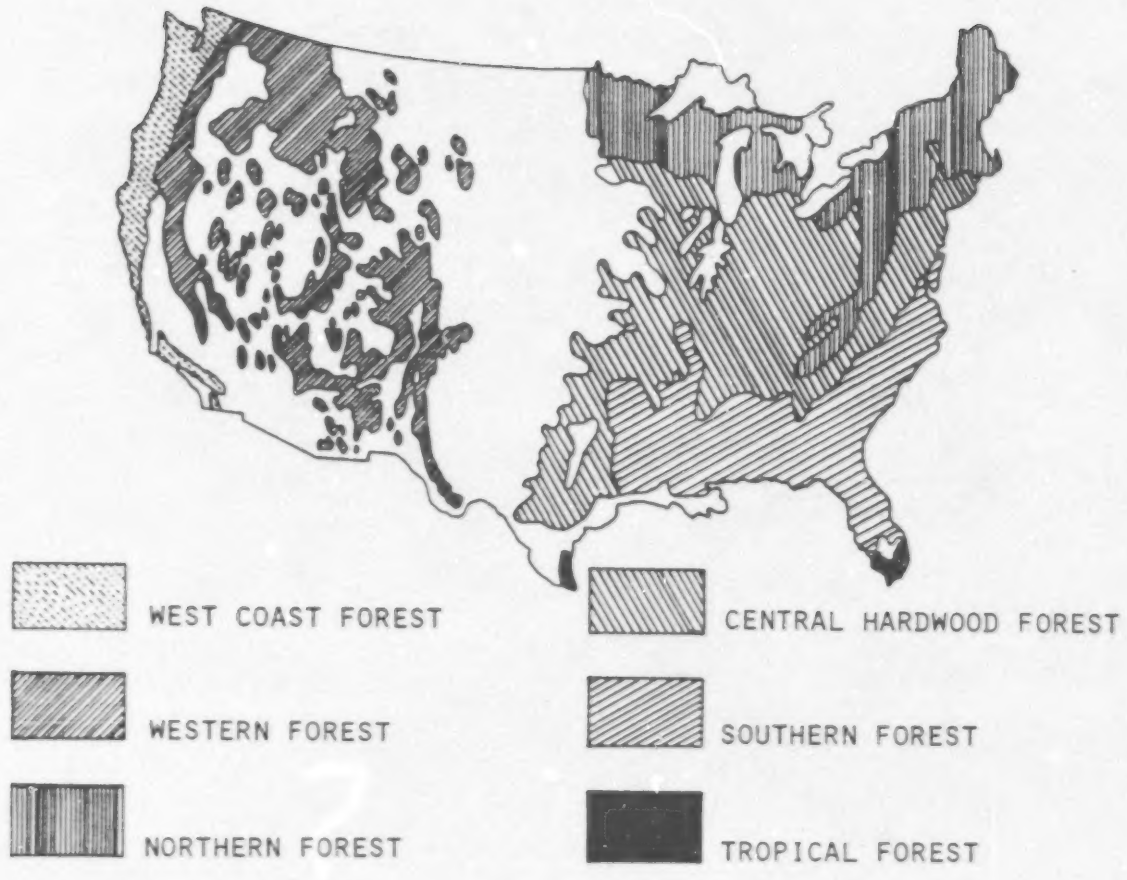


___ 5. The highest grade of hardwood is—
A. select
B. common
C. yard lumber
D. first and seconds

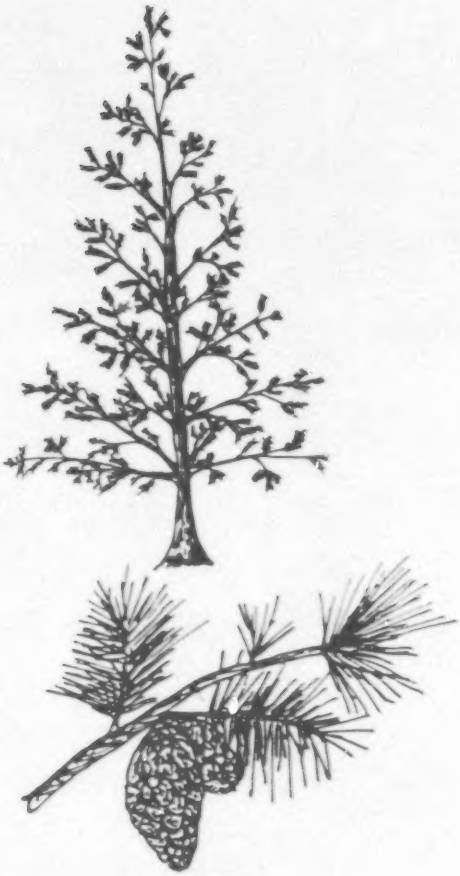
___ 6. A board measuring 12' x 6' x 1' contains how many board feet?
A. 3
B. 4
C. 5
D. 6

___ 7. What manmade wood product is made of individual wood fibers held together by lignin?
A. plywood
B. hardboard
C. particle or flake board
D. veneer

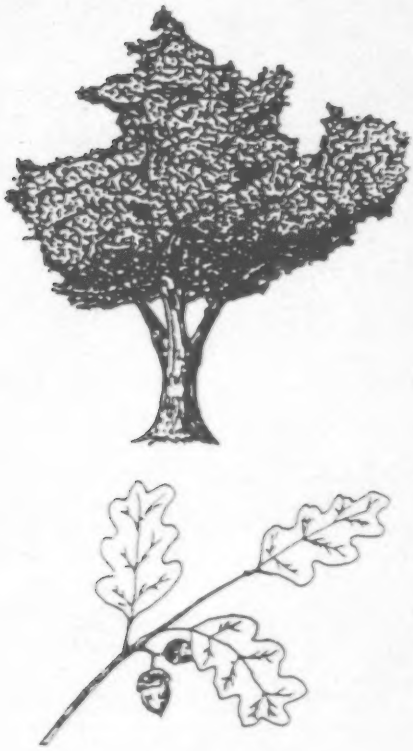
AREAS OF FOREST RESOURCES



HARDWOODS AND SOFTWOODS

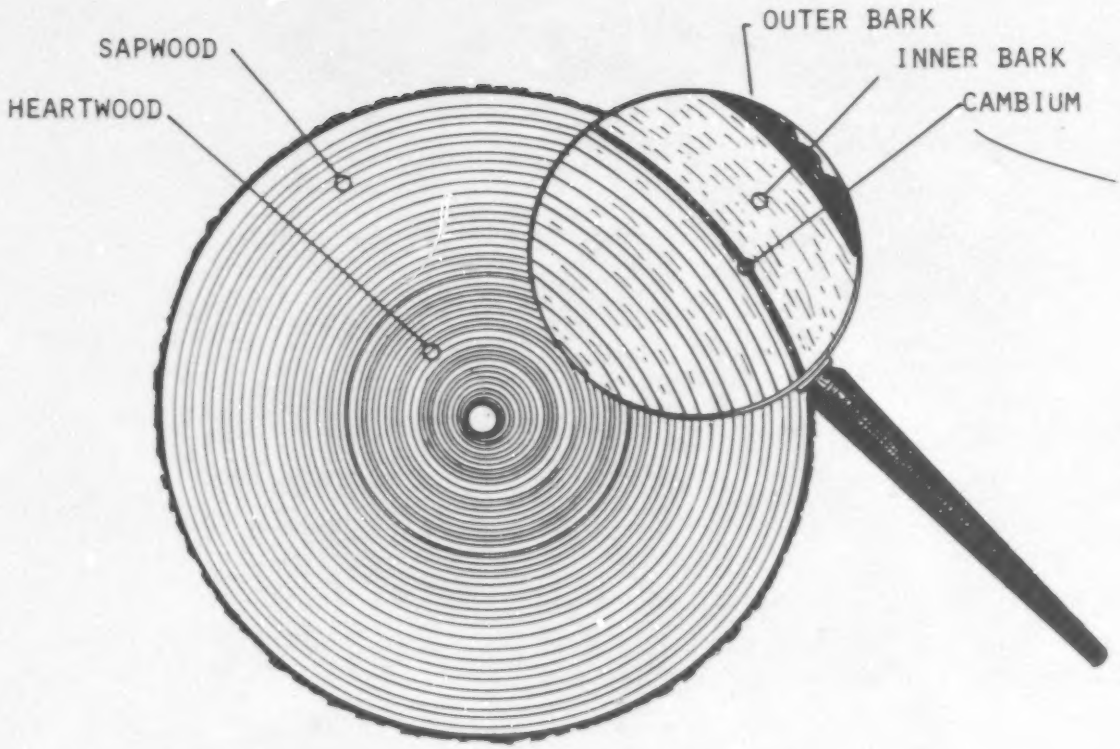


SOFTWOOD
(CONIFERS)

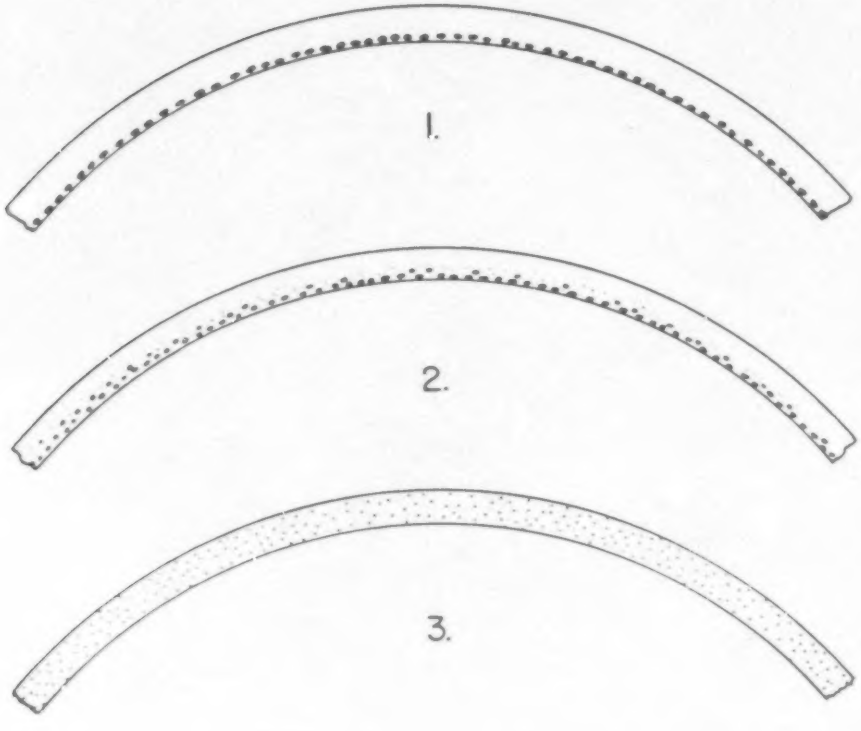


HARDWOOD
(BROADLEAVES)

MAJOR PARTS OF A TREE TRUNK

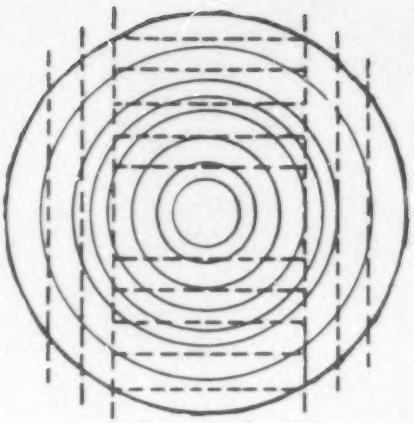


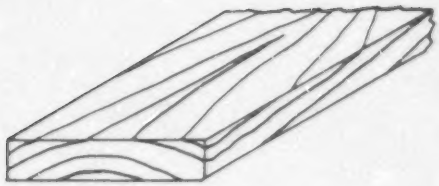
PORE ARRANGEMENT PER ANNUAL RING
(HARDWOODS)



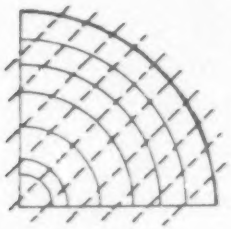
1. RING POROUS (OAK, ASH)
2. SEMI-DIFFUSED POROUS (WALNUT, MAHOGANY)
3. DIFFUSED POROUS (MAPLE, BIRCH, CHERRY)

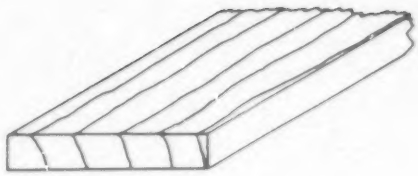
TYPES OF CUTS



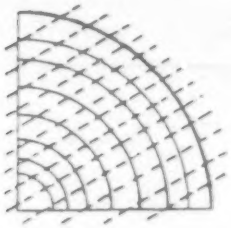


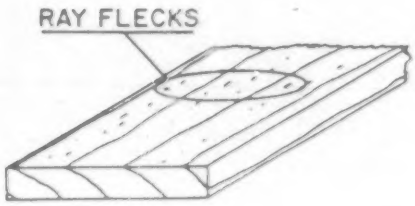
FLAT (PLAIN) SAWN





QUARTER SAWN

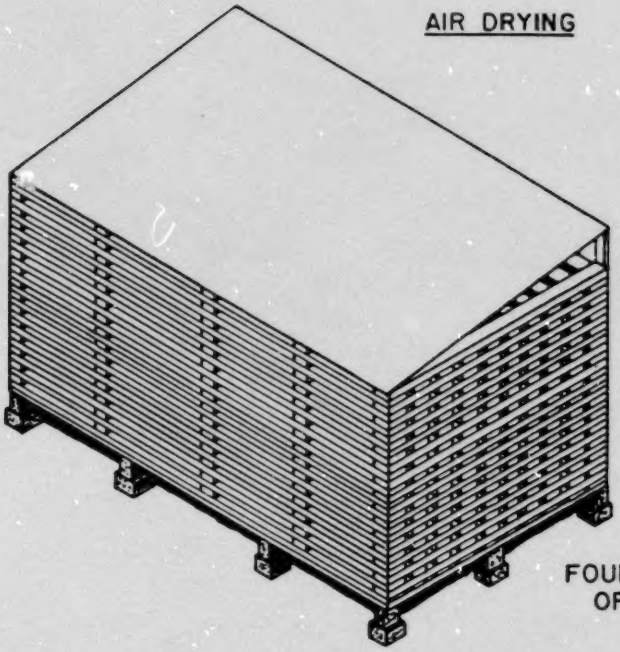




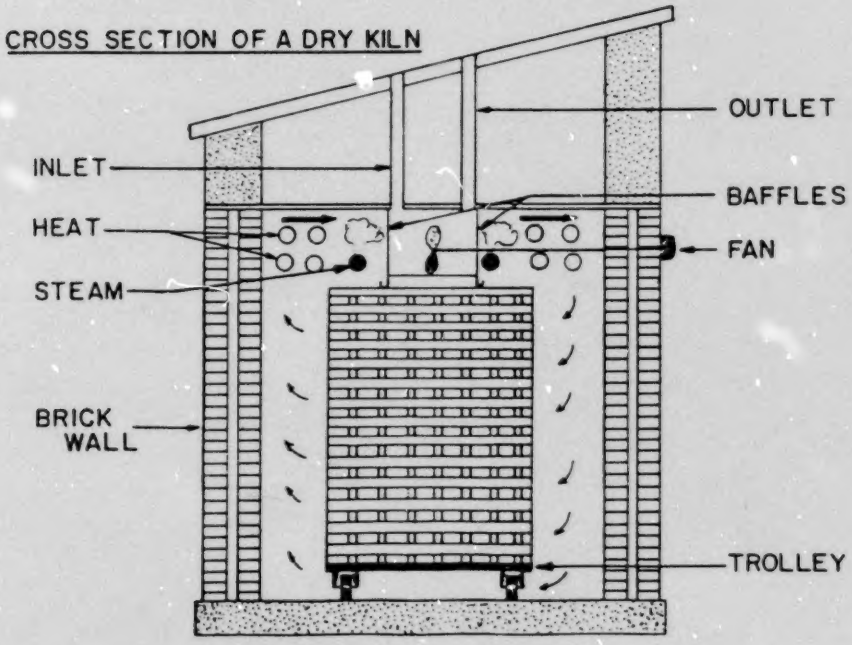
RIFT SAWN

DRYING LUMBER

AIR DRYING

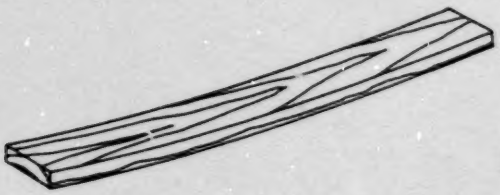


CROSS SECTION OF A DRY KILN

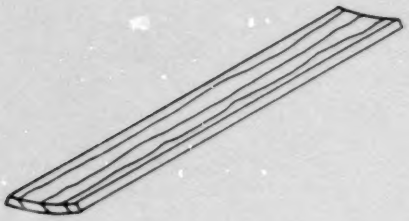


TYPES OF WARP

CROOK



BOW

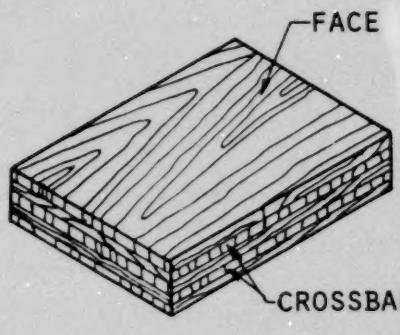


CUP

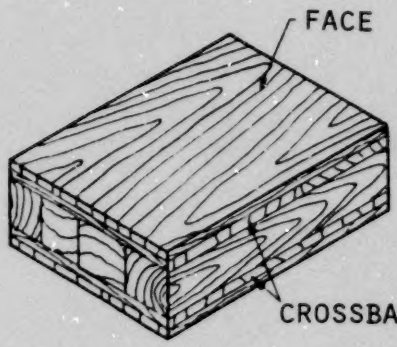
TWIST

PLYWOOD MANUFACTURING

PLYWOOD TYPES

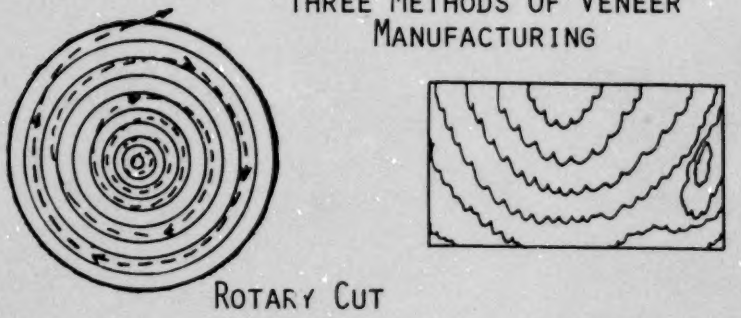


VENEER CORE CONSTRUCTION

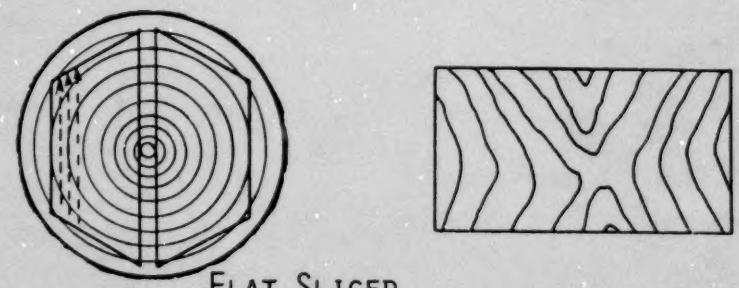


LUMBER CORE CONSTRUCTION

THREE METHODS OF VENEER MANUFACTURING



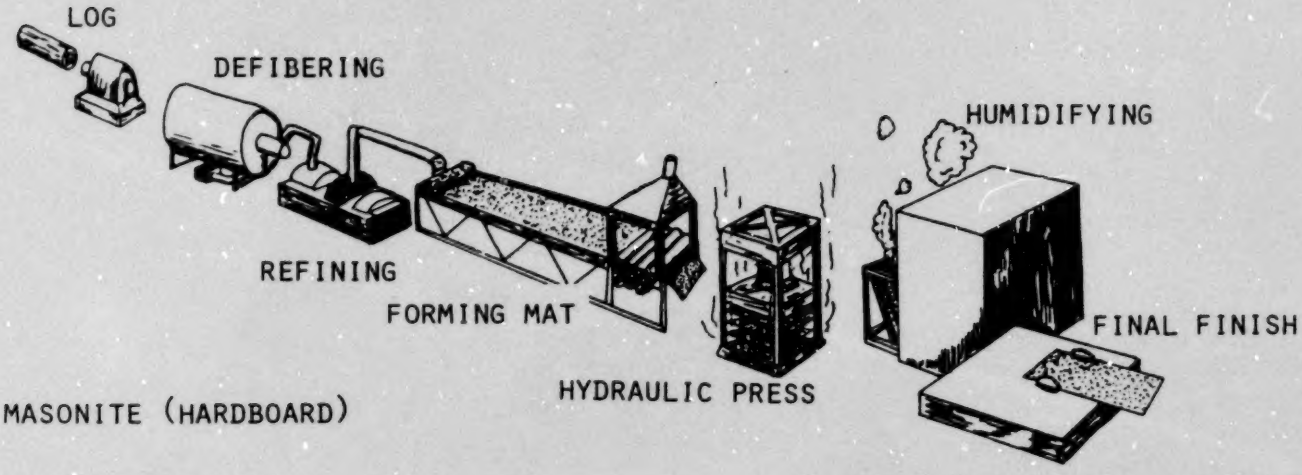
ROTARY CUT



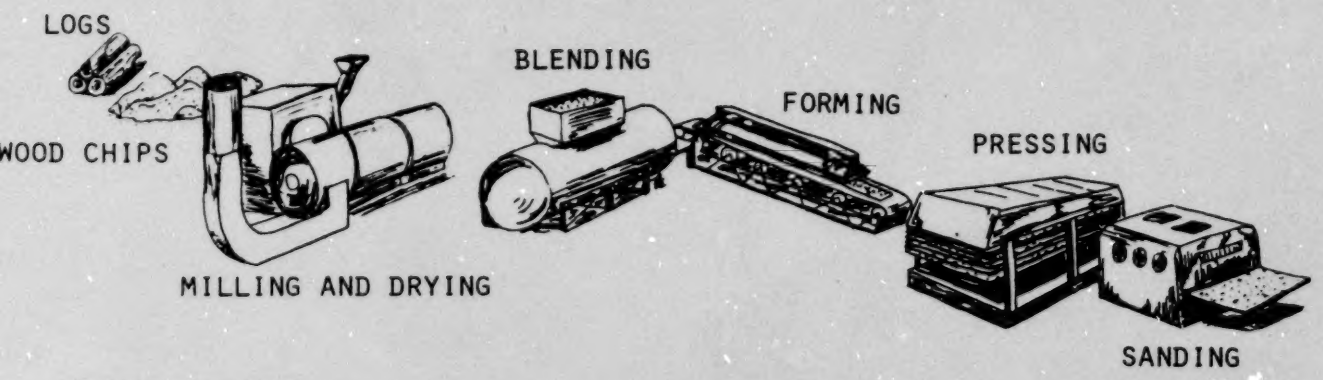
FLAT SLICED

QUARTER SLICED

GRAIN TYPES



MASONITE (HARDBOARD)

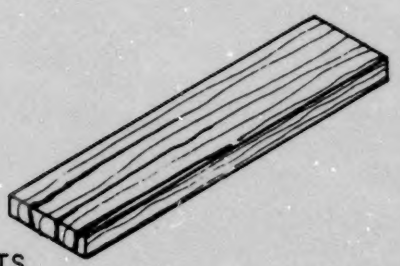


PARTICLE BOARD

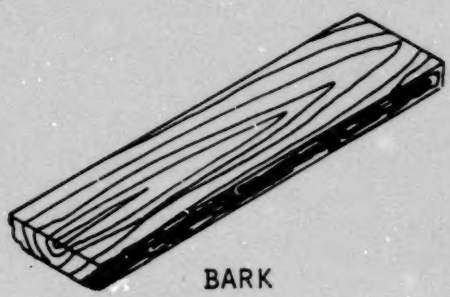
SOME COMMON WOOD DEFECTS

INGROWN KNOT

SPIKE KNOT



SPLITS



WANE

BARK

4

Designing, Joining, Planning, and Material Layout

INTRODUCTION

Designing, joining, planning, and material layout are important concepts for students to understand and use correctly. When these four concepts are taught through the problem-solving technique, they offer the students an opportunity to develop critical thinking skills that can be applied to other real-life situations.

Take time to teach the fundamentals of designing a product. Remember, a poorly designed product will be a poor product after it is built no matter how expensive the materials or how fine the workmanship. Second, it is important for a student to understand the basic wood joints, adhesives, and mechanical fasteners used in woodworking. This information is essential for moving on to the next step of planning. Third, careful planning is important to minimize mistakes and result in a quality product. A well-planned product will include a working drawing, a bill of materials, and a procedure sheet. Finally, proper and accurate material layout is needed to minimize material waste and errors resulting from improper layout.

OBJECTIVES

After students have covered material in this unit, they should be able to—

1. use the fundamental principles of design in designing a product;
2. identify and properly use wood joints;
3. identify and properly use adhesives and mechanical fasteners;
4. sketch a product;
5. develop a working drawing;
6. complete a bill of material;
7. complete a procedure sheet; and
8. use layout tools.

KEY WORDS: VOCABULARY

The words listed below may be new to the students studying woodworking. Teachers should help students understand these words as they are used in this topic of study.

design
form
function
formal balance
informal balance
proportion
harmony
emphasis
joint
adhesive
glue
mechanical fasteners
sketch
working drawing
bill of material
procedure sheet

TEACHING AIDS

- Overhead projector
- Examples of poorly designed products and well designed products
- Examples of common wood joints
- Examples of common wood adhesives
- Examples of common wood fasteners
- Examples of properly planned products
- Examples of layout tools

- Test Key: 1-C, 2-B, 3-A, 4-B, 5-D, 6-C, 7-B, 8-B, 9-D, 10-B, 11-D, 12-A, 13-D, 14-A, 15-C, 16-C.
- Transparencies: You will find transparencies W4-1 through W4-12 at the end of this unit. If you wish, these masters may be duplicated in quantity and given as handouts to the students while they are studying different aspects of this unit.

W4-1: Balance
W4-2: Harmony
W4-3: Emphasis
W4-4: Proportion
W4-5: Style
W4-6: Wood Joints
W4-7: Pencil Sketching
W4-8: Orthographic Projection
W4-9: Isometric Projection
W4-10: Bill of Materials
W4-11: Plan of Procedure
W4-12: Measuring Tools

SUGGESTED REFERENCES

Feirer, J.L. Cabinetmaking and Millwork. Peoria, Ill.: Bennett Publishing Company, 1982.

Hammond, J.J.; Donnelly, E.T.; Harrod, W.F.; and Rayner, N.A. Woodworking Technology. Bloomington, Ill.: McKnight Publishing Company, 1980.

Hutchings, G.R.; Martin, G.E.; and Coleman, J.M. Working with Wood. Bloomington, Ill.: McKnight Publishing Company, 1982.

SENTENCE OUTLINE

I. Design (definition: by intention or by plan) is when a product is planned to fulfill a particular function and not built just hoping that a use can be found for it. The form then follows to meet functional requirements of the product.
   A. "Form follows function" is the most important basic principle underlying all design.
   B. Function is the intended use of product.
   C. Form is the shape the product will take.
   D. Often, woodworkers are more concerned with the building of a product than with the function of the product and the form it will take. This practice often results in a useless and ugly product with little sales appeal.
   E. Well-designed products are often copies or modifications of successfully designed products. Students should be encouraged to bring in pictures of products they wish to build and then modify them to fit their particular product's function.
   F. Balance is achieved when an object appears stable or at rest. (Transparency W4-1)
      1. Formal balance is symmetrical balance. If a formal balance object were cut in half, the two halves would be mirror-images of each other.
      2. Informal balance is asymmetrical balance. That is, the two halves of an object are not mirror images of each other, but the mass of one half will nearly equal the mass of the other half.
   G. Proportion is an important part of balance and deals with the size relationships of parts to a whole or objects to objects. (Transparency W4-4)
      1. A very tall back on a chair is said to be out of proportion with the rest of the chair.
      2. A large lamp set on a small table represents two objects that are out of proportion with each other.
      3. Common proportions are:
         1. 1 to 3
         2. 2 to 3
         3. or the golden rectangle 1 to 1.618 or 5 to 8
   H. Harmony is achieved when there is continuity between the parts that make up a product. A square table top supported by round legs or a massive top supported by thin legs violate the principles of harmony. (Transparency W4-2)
   I. Emphasis is a design principle that is used to attract a viewer eye to a certain part of a product. An example would be to place an inlay in the center of a table. (Transparency W4-3)

J. Honest use of material is a design principle in which materials are to look like themselves and not something else. A violation of this rule is when plastic laminate (formica) is made to look like wood.

K. The product that is designed should have a recognizable style. If the designed product is a piece of furniture it should fit into one of the following styles: (Transparency W4-5)

1. French Provincial
   a. A fine line of furniture characterize by graceful curves, delicate proportions, and ornate design, it is considered the feminine style of furniture.
   b. This design was developed during the late 18th century.
   c. The cabriole leg is almost universal in this style of furniture.
2. Traditional
   a. Developed during the 18th century by cabinetmakers such as Hepplewhite, Shoraton, and the Adams brothers.
   b. This style uses mahogany.
   c. It also uses fine carvings and inlays.
   d. The ball and claw on the feet of the legs is used extensively.
3. Italian Provincial
   a. This is a simplified version of many more ornate styles of furniture.
   b. It uses many straight lines, including tapered legs.
   c. Recesses, fluting, inlays, and overlays are used to enhance design qualities.
4. Modern or contemporary
   a. Often straight-lined, this style is considered the masculine style of furniture.
   b. Many different materials are used in its construction including glass, wood and metal.
   c. This style adapts to many different uses (example-sleeper sofa).
5. Spanish or Mediterranean
   a. This design uses many materials including ceramic, wrought iron, fine woods, and glass.
   b. Carved panels and horseshoe-styled arches are characteristic of this style.
6. Colonial or Early American
   a. The original design was developed between 1608-1830 in America.
   b. It uses native American woods such as oak, pine and maple.
   c. These products are often assembled with wooden pegs instead of metal fasteners.
   d. Early American pieces tend to be simple such as benches, chests, and the trestle table.
   e. Colonial pieces tend to be more ornate with the use of turned parts.

L. Common Errors in Design

1. Basic design principles such as "form follows function" and appearance are ignored giving the product a school-made look. Often the product is heavy, lacking harmony, and clumsy in appearance, instead of being light and attractive.
2. Poor workmanship will lead to a poor product if joints do not fit tight, or the product is out of square.
3. Poor or improper selection of materials. A quality piece of furniture cannot be made from poor quality materials. Also, it is foolish to combine several pieces of highly-contrasting woods together in one product (example-a cutting board made of alternately spaced strips of maple and walnut).
4. Over-decoration can be a problem if not used properly. Certain styles of furniture call for decoration while others such as contemporary and modern do not.

5. A poor finish can ruin the effect of an otherwise well-built and well-designed piece of furniture. Remember, it is the finish of a wooden product that people will see first. Experiment carefully on sample blocks until the right finishing combination is achieved.

II. Wood construction and fastening techniques should be explored before planning a project.

A. Joints are used to connect two or more pieces of wood. Whenever two or more pieces of wood come together a joint is formed. Common joints are: (Transparency W4-6)
   1. Butt
   2. Miter
   3. Rabbet
   4. Dado
   5. Dowel
   6. Mortise and tenon
   7. Tongue and groove
   8. Dovetail
   9. Cross lap

   Note: The first three joints have no strength of their own and rely totally on the strength of the adhesion and/or mechanical fasteners used. The remaining six joints have some mechanical strength of their own.

B. Glues and adhesives rely on cohesion and adhesion for their bonding strength.
   1. An adhesive is a synthetic (man-made) material.
   2. A glue is derived from natural sources such as animal hide glue.
   3. Adhesion is the ability of a glue or adhesive to bond to the wood.
   4. Cohesion is the ability of the glue or adhesive to bond to itself.
   5. Common adhesives are:
      a. Polyvinyl acetate (common liquid white adhesive)
      b. Alaphatic (cream-colored liquid adhesive)
      c. Plastic resin (tan powder)
      d. Resorcinol resin (two part adhesive that is 100% waterproof)
      e. Contact cement (must be applied to both surfaces prior to adhering)
      f. Epoxy (used to adhere unlike materials to wood)

C. Mechanical fasteners
   1. Nails are common metal fasteners used in wood.
   2. Nails are driven into wood usually with a hammer and they rely on the friction between the nail and wood fibers for their strength.
   3. Different nail types are:
      a. Escutcheon pins
      b. Brads
      c. Finishing nails
      d. Casing nails
      e. Common nails
   4. Nail size can be given in length and gauge size as commonly used in brad sizing, or in penny size commonly used with nails.
   5. Screws are also commonly used in wood and their holding power is greater than nails.
   6. Screws are twisted into wood with the screw thread cutting into the wood fibers. This gives screws a very strong mechanical grip in the wood.
   7. Screw sizes are commonly given in two numbers such as $1\frac{1}{2}$" - 10 which means the screw is $1\frac{1}{2}$" long and has a number 10 wire diameter.
   8. Screws used in woodworking commonly come with three head designs.
      a. flat
      b. round
      c. oval

III. Planning a product
   A. The first step in planning a product is to determine its functional requirements (what it is to be used for).
   B. Next, examples of existing similar products should be collected to determine if an existing design should be used or modified, or if a product will have to be designed from scratch.
   C. Sketches should be made of several possible forms of the product keeping in mind its function and appearance. (Transparency W4-7)
   D. The best sketches should be developed into a proportionally correct model of the product. Paper, cardboard, and balsa can be used to build model.
   E. Working drawings need to be developed from the sketches and models. These drawings are often drawn in:
      1. Orthographic (Transparency W4-8)
      2. Isometric (transparency W4-9)
   F. Dimensioning a drawing is important for a woodworker to determine the size of various parts.
   G. From the working drawing a bill of materials must be figured, listing the rough and finished sizes of materials and their costs needed to build the product. (Transparency W4-10)
   H. A plan of procedure needs to be developed which will list in logical order the steps needed to complete the construction of the product. (Transparency W4-11)

IV. Material layout
   A. Proper layout of materials is an important step to assure that a minimum amount of material is wasted and that parts are cut to the right size.
   B. Material measurement is important and the following layout tools should be examined (Transparency W4-12):
      1. Bench rules are made of wood with brass inserts on each end to minimize the mean. They come in one-, two-, and three-foot lengths and are used to measure short distances.
      2. Rulers can be made of various materials and are usually divided in 1/16", 1/8", and 1/4" graduations.
      3. Folding or zigzag rulers are used by cabinet makers and carpenters for making rough layouts. They usually come in six- or eight-foot lengths and can be folded into a compact size.
      4. Tape measures come in lengths from 6 feet to 100 feet and are used for making longer measurements.
   C. Squares are important layout tools which are used to draw perpendicular and angled lines.
      1. Combination square has a sliding head and can be used to lay out perpendicular and 45° lines easily. It can also be used for measurement and it contains a glass vial with an air bubble in its head which is used to check if an object is level.
      2. Try square is a very accurate tool for laying out and checking perpendicular lines and cuts. The try square can also be used for measurement.
      3. Framing or carpenter's square is a large steel square that is helpful when laying out large pieces of stock. Carpenters find this square very useful in laying out roof rafters and stairs.
      4. Sliding T-bevel is used to check and transfer angles on wood. The blade can be set with a protractor or a square from 0° to 180°.
   D. Marking tools are used to make clear and sharp layout lines. These lines are then used as guides for sawing and shaping wood.
      1. Pencils are commonly used for layout because they leave a visible mark that can later be easily sanded or erased before finishing. Pens should never be used because they tend to indent and stain the wood which makes finishing more difficult.
      2. A marking gauge is very useful in laying out lines parallel to an edge.

3. Chalk lines are used to lay out long straight lines. A line coated with chalk is stretched between two points and then the line is snapped. The chalk marks the wood where the line hit.
4. A scratch awl is used to make light scratches in a piece of wood although it is most commonly used to make the locations of holes.
5. A compass is commonly used to draw circles and arcs, with dividing lines.

E. Other layout considerations
   A. Patterns can be drawn and cut out of paper and cardboard to make duplicate parts.
   B. Grain direction must be taken into consideration when laying out wood.
   C. Defects in the lumber must be worked around.
   D. Kerf allowance must also be planned for in layout.
   E. Always recheck your layout and think ahead before making any cuts.

MATERIALS FOR STUDENTS

- Vocabulary worksheet
- Paper for sketching and drawing
- "Bill of material" forms
- Procedure sheets
- Material to build project
- Magazines and other material from which to get product ideas

SUGGESTED STUDENT ACTIVITIES

1. Design a product to meet certain criteria established by the teacher. Example: Students are to design a functional and eye-appealing box to store 5" x 8" index cards. The box is to be built from a 1" x 12" x 30" piece of pine and incorporate a $\frac{1}{4}$" plywood bottom.
2. Sketch various product designs and select the best one.
3. Develop a working drawing from the sketch.
4. Complete a "bill of materials" for the product.
5. Complete a procedure sheet for the product.
6. Demonstrate the various layout tools.

Vocabulary Worksheet

1. design
2. form
3. function
4. formal balance
5. informal balance
6. proportion
7. harmony
8. emphasis
9. joints
10. adhesives
11. glue
12. mechanical fasteners
13. sketch

14. working drawing

15. bill of materials

16. procedure sheet

TEST

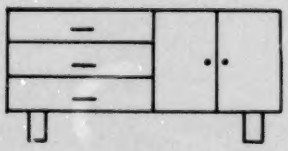
Unit 4: Designing, Joining, Planning, and Material Layout

Directions: Read each statement carefully. Select the one word, or phrase, that correctly answers or completes the statement. Write the appropriate letter in the blank.

Example: __D__ 21. The class you are in is—
A. Science
B. English
C. Art
D. Industrial Technology

___ 1. When designing a product what is the **most** important consideration?
A. form
B. material used in its construction
C. function
D. color

___ 2. The illustration to the right represents a product with _____ balance.
A. formal
B. informal
C. asymmetrical
D. modern

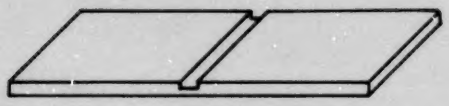


___ 3. What part of the chair illustrated to the right is out of proportion with the rest of the chair?
A. back
B. legs
C. seat
D. rails

___ 4. What style of furniture often has straight lines, uses more than one material in its construction and is adaptable to several uses?
A. French Provincial
B. modern
C. traditional
D. Early American

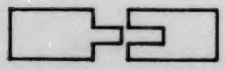
___ 5. What style of furniture is considered feminine because of its graceful curve, delicate proportions, carvings, and use of the cabriole leg?
A. traditional
B. Italian Provincial
C. modern
D. French Provincial

___ 6. Identify the wood joint to the right.



A. butt
B. miter
C. dado
D. dowel

___ 7. Identify the wood joint to the right.



A. dowel
B. mortise and tenon
C. tongue and groove
D. dovetail

___ 8. What statement is true concerning glues and adhesives?
A. A glue is man-made.
B. A glue is derived from natural materials.
C. An adhesive is derived from natural materials.
D. An adhesive holds better than glue.

___ 9. Which of the following adhesives would be best for gluing a boat together where the joints had to be 100% waterproof?
A. alaphatic
B. polyvinyl acetate
C. plastic resin
D. resorcinol

___ 10. What type of fastener generally has better holding power in wood?
A. nails
B. screws
C. A and B both hold about the same
D. brads

___ 11. What is the first step in planning a product?
A. selecting the material
B. determining its form
C. sketching the product
D. determining its function

___ 12. Which of the following lists a product's part by size and is used to estimate its cost?
A. bill of materials
B. drawing
C. procedure sheet
D. sketch

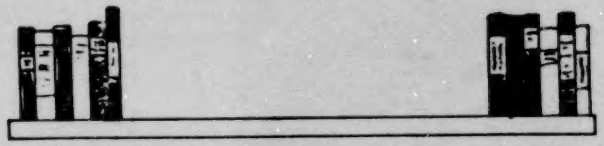
___ 13. Which of the following measuring tools would be best for determining the length of the woodworking laboratory?
A. bench rule
B. ruler
C. folding ruler
D. tape measure

___ 14. Which of the following squares can be used to lay out perpendicular lines at 45o angels, measure distances, and determine if an object is level?
A. combination square
B. try square
C. carpenters square
D. T-bevel

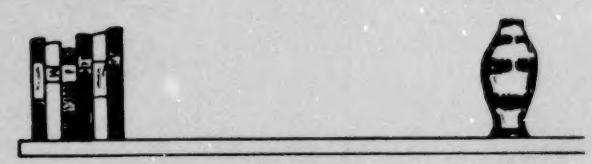
___ 15. Which of the following layout tools can be used to transfer a 30° angle from a protractor to a piece of wood?
A. try square
B. combination square
C. T-bevel
D. carpenters square

___ 16. What would be the proper tool to draw a circle with?
A. marking gauge
B. chalk line
C. compass
D. scratch awl

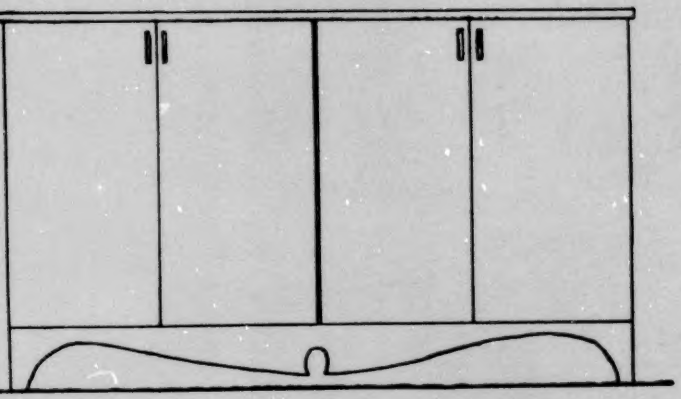
BALANCE

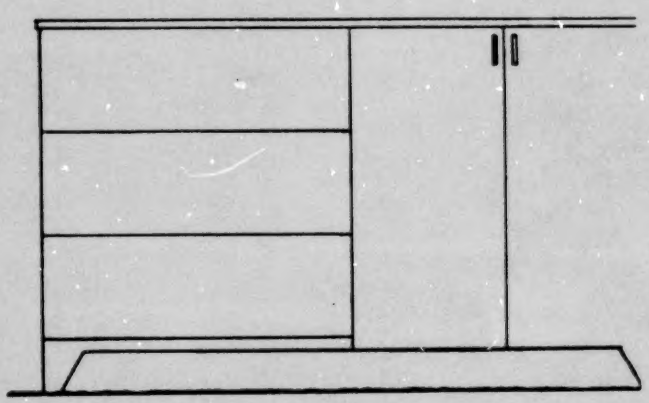


FORMAL



INFORMAL





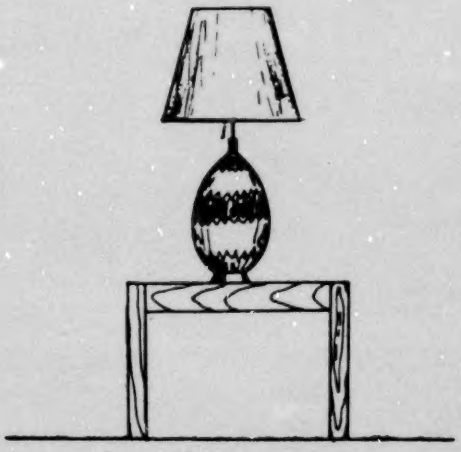
HARMONY

1x3

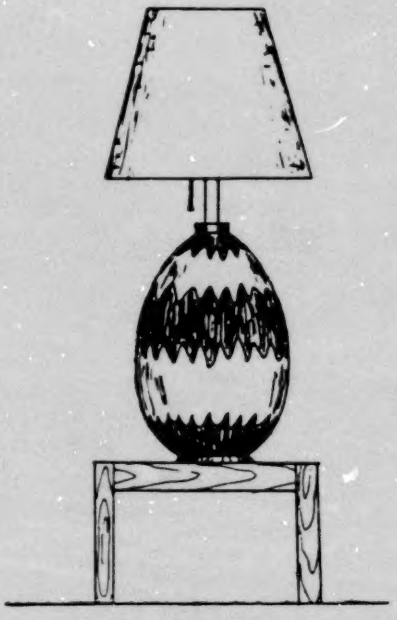
1x2

5x8

COMMON PROPORTIONS

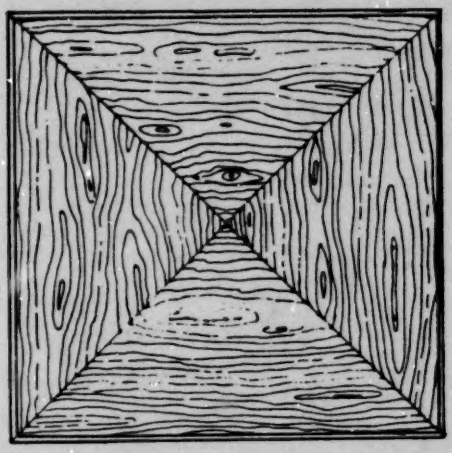


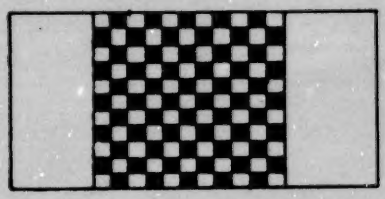
HARMONY

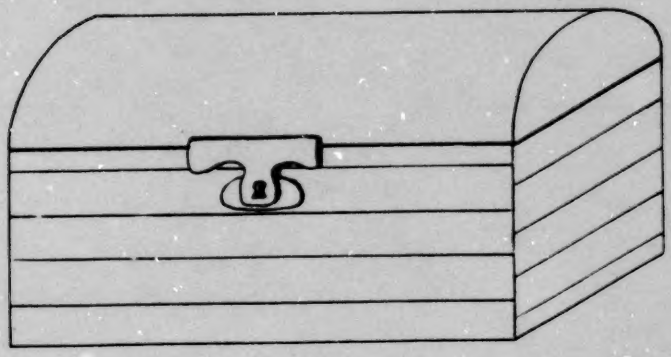


NO HARMONY

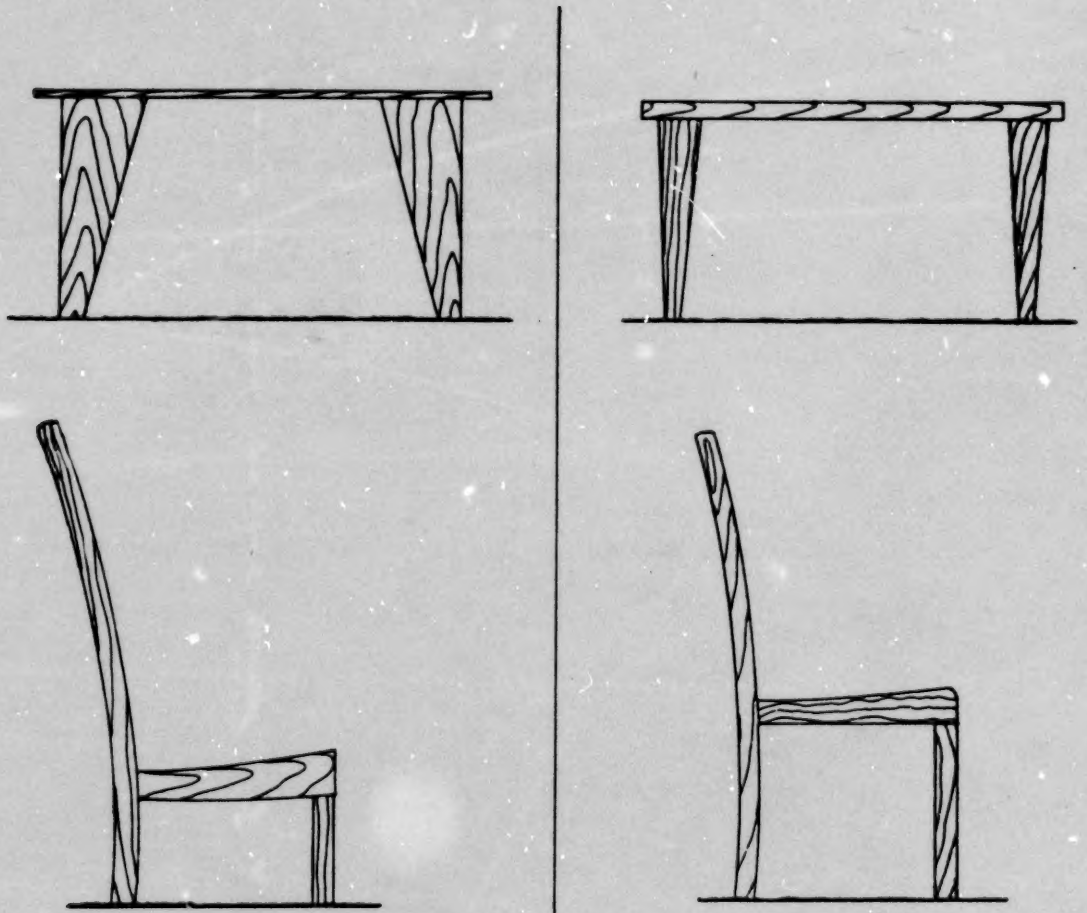
EMPHASIS







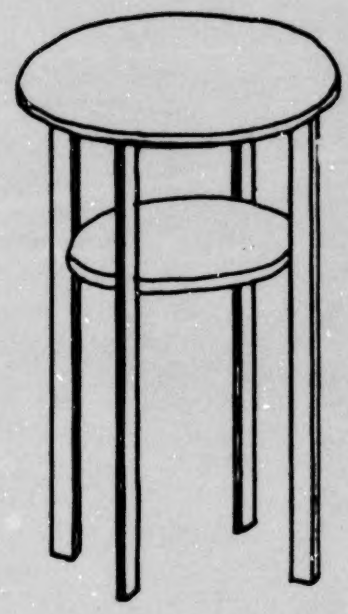
PROPORTION



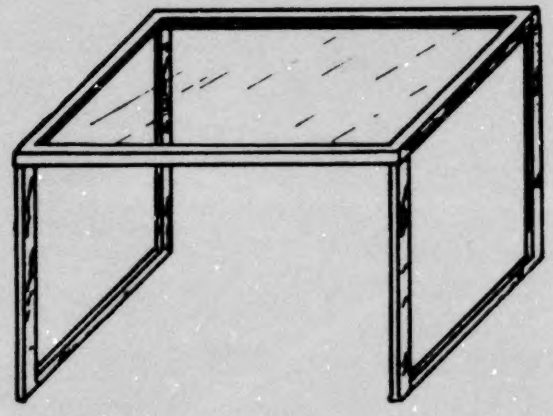
INCORRECT

CORRECT

STYLE

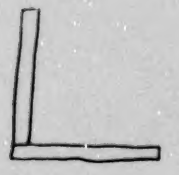


No Identifiable Style

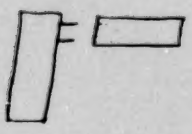


Modern Style

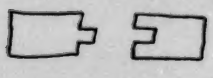
WOOD JOINTS



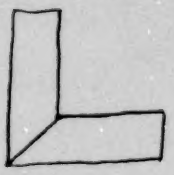
BUTT



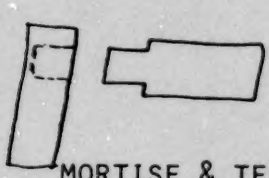
DOWEL



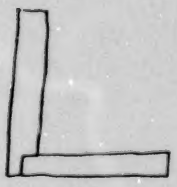
TONGUE & GROOVE



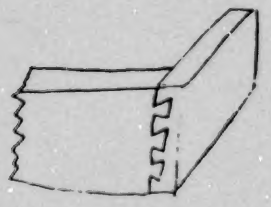
MITER



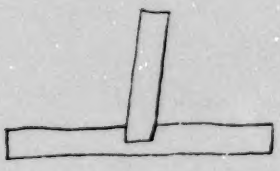
MORTISE & TENON



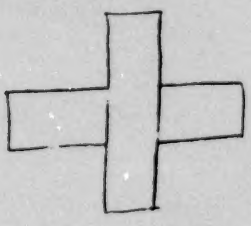
RABBET



DOVETAIL



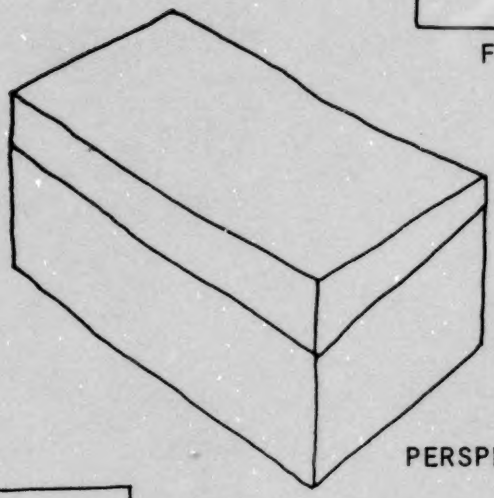
DADO



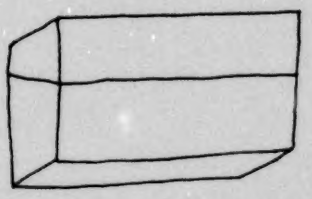
CROSS LAP

PENCIL SKETCHING

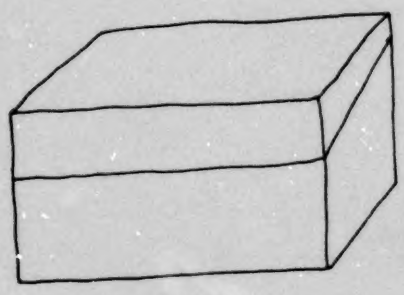
FRONT VIEW



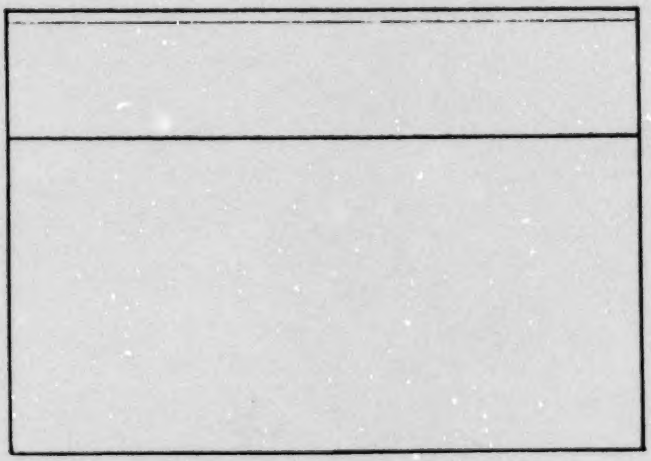
PERSPECTIVE VIEW

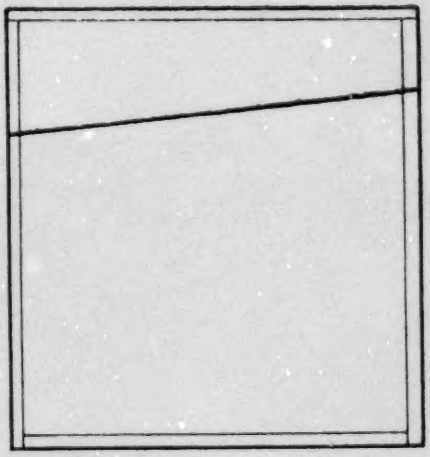


OBLIQUE VIEWS

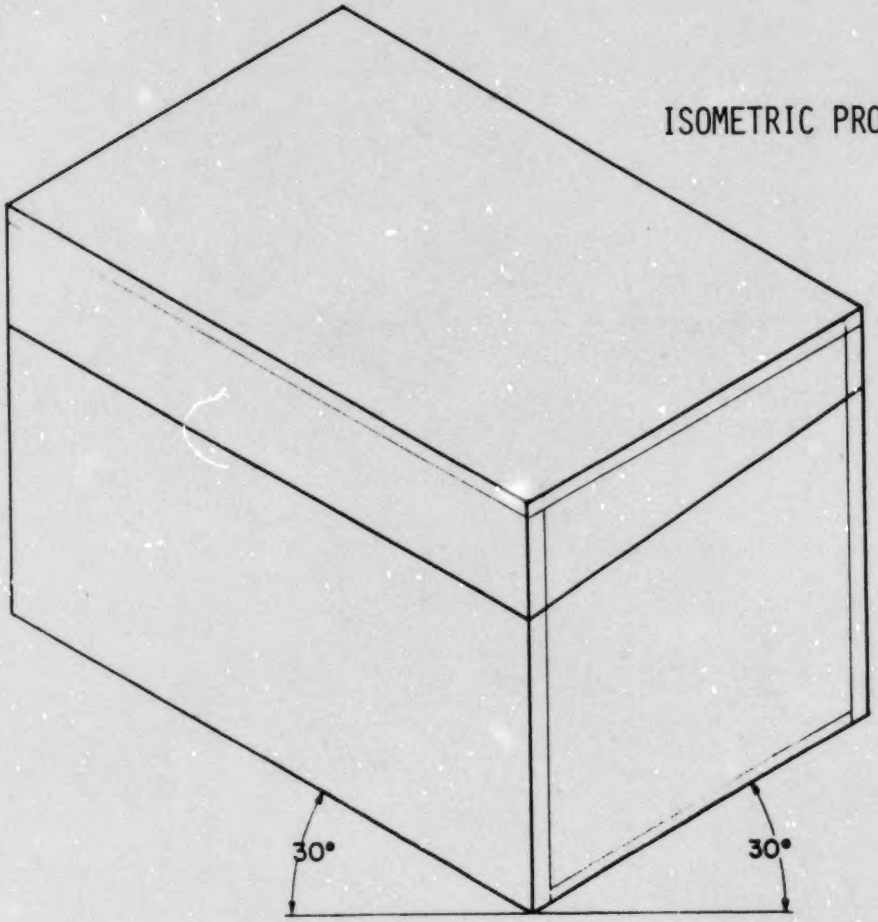


ORTHOGRAPHIC PROJECTION





ISOMETRIC PROJECTION



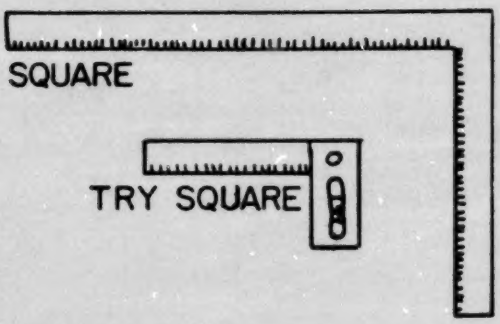
BILL OF MATERIALS

Quant.	Materials	Size	Unit Cost	Cost
			TOTAL	

PLAN OF PROCEDURE

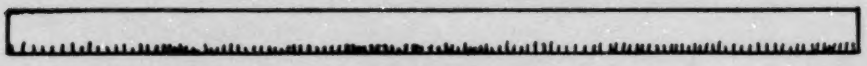
Step No.	Operation

STEEL TAPE

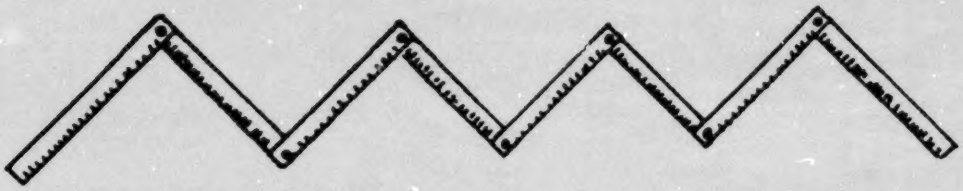


SQUARE

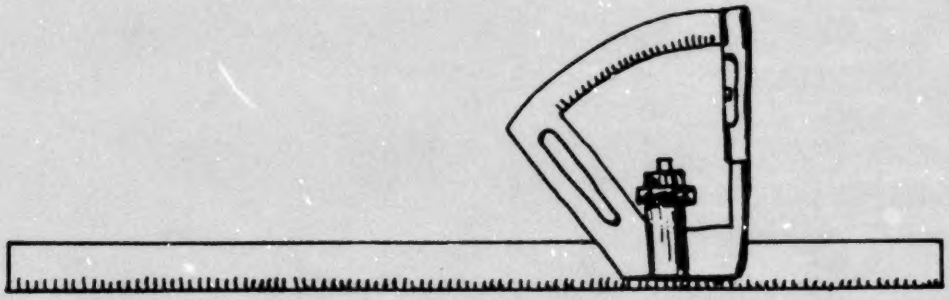
TRY SQUARE



STEEL RULE



FOLDING WOOD RULE



COMBINATION SQUARE

MEASURING TOOLS

5

Safety and Health Environment

INTRODUCTION

The safety and health environment of a woodworking laboratory should be foremost in the instructor's and student's mind. A serious accident that happens to anyone is caused for concern; but when it happens to a young person, it is even more tragic. Young people will have to live with the results of a maiming accident for the rest of their lives (perhaps 60-70 years). The instructor must be reasonable and prudent in providing a safe working environment, including safety instructions for students. An instructor who is not, may be subject to potential legal action if an accident occurs because of the instructor's negligence. The woodworking laboratory has the potential of being the most dangerous laboratory of those commonly found in school. The accident rate for industrial woodworking has been found to be about twice as high as the national average for all industries. This is because woodworking is done with many sharp cutting tools and high speed machines. This unit will cover general safety rules for the woodworking laboratory, with more specific safety rules to follow in chapter 6.

The Occupational Safety and Health Act (OSHA) was passed in 1970. The intent of OSHA was to establish safety standards for industry to follow. These standards require industry to protect their workers from injury. Also, OSHA set safety standards for equipment and machinery manufacturers. OSHA has indirectly affected the school laboratory. New equipment bought by schools will now meet OSHA standards. Also, some OSHA regulations have reached the school level, such as the wearing of eye protection and the storing of flammable liquids in flame-proof cabinets. Students should become aware of standard OSHA safety colors used in a woodworking environment. Instructors should take care to use OSHA safety colors in the laboratory.

OBJECTIVES

After the students have covered the material in this unit, they should be able to—

1. identify proper clothing to be worn in the woodworking laboratory;
2. describe what special precautions need to be taken with long hair;
3. explain the need for eye protection;
4. explain why jewelry is dangerous to wear in the woodworking laboratory;
5. locate in the laboratory:
   a. emergency stop buttons (if installed)
   b. first aid kit
   c. safety zones
   d. dust collector switch
   e. fire extinguisher
   f. other safety features
6. describe the four basic OSHA safety colors used in the laboratory and what they signify;
7. describe the proper first aid procedure to be followed in case of an accident; and
8. describe the general safety rules that will be followed in the laboratory.

KEY WORDS: VOCABULARY

The following key words may be new to the students studying safety in a woodworking laboratory. The teacher should help the students understand these words as they are used in this unit of study.

safety
safety zones
Occupational Safety and Health Act (OSHA)
first aid
horseplay
eye protection

TEACHING AIDS

- Overhead projector
- Test Key: 1-B, 2-C, 3-E, 4-B, 5-C, 6-A, 7-D
- Transparencies: You will find transparencies W5-1 and W5-2 at the end of this unit. If you wish, these masters may be duplicated in quantity and given to the students as handouts while they are studying different aspects of this unit.
  W5-1: Safety Posters
  W5-2: Safety Aids

SUGGESTED REFERENCES

Feirer, J.L. Basic Woodworking. Peoria, Ill.: Charles A. Bennett Company, 1978.

Hammond, J.J.; Donnelly, E.T.; Harrod, W.F.; and Rayner, N.A. Woodworking Technology. Bloomington, Ill.: McKnight Publishing Company, Inc., 1980.

Hutchings, G.R.; Martin, G.E.; and Coleman, J.M. Working with Wood. Bloomington, Ill.: McKnight Publishing Company, 1982.

Los Angeles Unified School Districts. Woodworking. Encino, Calif.: Glencoe Publishing Company, 1978.

SENTENCE OUTLINE

I. Personal safety
   A. The type of clothing worn by students to class is very important.
      1. Open-top shoes such as sandals and thongs should not be allowed in the laboratory. A chisel falling from a bench could cause a serious injury.
      2. Loose fitting clothing should be avoided. This type of clothing dangling near rotating equipment could get caught.
      3. Long pants are preferred over shorts or dresses.
      4. Short sleeves are preferred over long sleeves.
   B. Care must be taken to assure that long hair will not get caught in rotating machinery. Long hair can be tied back or worn under a hair net or cap.
   C. Eye protection, such as safety glasses, safety goggles, or a safety shield should always be worn when hand tools or power equipment is being used.
   D. Jewelry such as watches, bracelets, necklaces, and rings should be removed to prevent them from being caught.

II. Laboratory safety
   A. The instructor should point out the safety features of the laboratory.
      1. Emergency stop buttons (if installed)
      2. Location of first aid kit
      3. Safety zones
      4. Dust collector switch
      5. Fire extinguishers
   B. The instructor should familiarize the student with the four OSHA safety colors that should appear in the laboratory.

1. Orange—stands for hazardous areas where saw blades, jointer knives, belts, gears, and pulleys can be found. A person should keep hands and clothing away from these areas.
2. Yellow—stands for caution and can be used to locate safety zones behind machines. Caution signs with a yellow background and black print are also common.
3. Green—stands for safety items, such a first aid kits. New exit signs have a green background with white lettering.
4. Red—stands for emergency items such as stop buttons on machines and fire extinguishers.

III. First aid
   A. All injuries, no matter how small, should be reported to the instructor.
   B. The basics of first aid should be covered:
      1. Apply pressure to a wound to stop the bleeding.
      2. Clean and disinfect wounds.
      3. Cover wounds to prevent infection.
      4. Make sure major injuries are called to the attention of the school nurse or other medical personnel as the situation merits.

IV. General safety
   A. Students should not use any tool or piece of equipment until proper instruction is given.
   B. Students should not run or horseplay in the laboratory.
   C. Students should not eat or drink in the laboratory.
   D. Students should be sure the laboratory is neat and clean.
   E. Two students should carry a long board instead of just one to avoid hitting others.
   F. Do not leave items sticking out of a vise for others to run into.
   G. Always place tools and portable power equipment toward the center of the workbench to prevent them from being knocked onto the floor.

MATERIALS FOR STUDENTS

- Vocabulary worksheet
- Paper and writing material to make safety posters
- Handouts

SUGGESTED STUDENT ACTIVITIES

1. Give students a tour of the laboratory, pointing out various safety features. The following are some examples:
   a. fire extinguisher
   b. first aid kit
   c. location of nearest telephone for emergency calls
   d. safety zones
   e. safety glass locations
2. Have students develop safety posters identifying potential safety hazards.
3. Have students make improvements in the laboratory environment. Some examples are listed here:
   a. paint safety zones
   b. make push sticks and other safety devices
   c. color-code machinery according to OSHA
4. Give students a demonstration on how to administer first aid to an injured person.

Vocabulary Worksheet

1. safety

2. safety zones

3. Occupational Safety and Health Act (OSHA)

4. first aid

5. horseplay

6. eye protection

TEST

Unit 5: Safety and Health Environment

Directions: Read each statement carefully. Select the one word or phrase that answers the question or completes the statement correctly. Write the appropriate letter in the blank provided.

Example: D 21. The class you are in is—
A. Science
B. English
C. Art
D. Industrial Technology

___ 1. The commonly used abbreviation for the safety rules stemming from the Occupational Safety and Health Act is:
A. ASHA
B. OSHA
C. OSAH
D. AOSH

___ 2. What type of clothing should be worn in the woodworking laboratory?
A. sandals
B. loose-fitting clothing
C. short sleeve shirts
D. jewelry

___ 3. Which of the following could easily get caught in a machine?
A. necklaces
B. safety glasses
C. long hair
D. A and C

___ 4. Which of the following items is painted red?
A. first aid kit
B. fire extinguisher
C. machine safety guards
D. caution signs

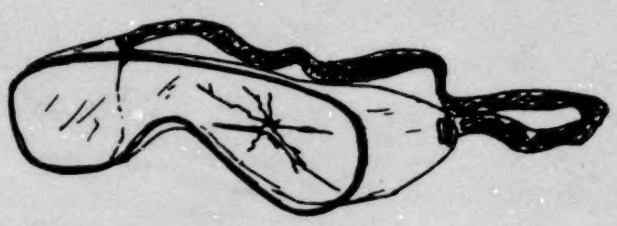
___ 5. What safety color stands for hazardous areas where knives, blades, pulley or gears could be moving and cause injuries if proper precautions are not taken?
A. red
B. green
C. orange
D. yellow

___ 6. The instructor should be notified of:
A. all injuries
B. only major injuries
C. only accidents requiring the use of band-aids
D. eye injuries only

___ 7. Which of the following should not be done in the laboratory?
A. running
B. eating and drinking
C. horseplay
D. all of above

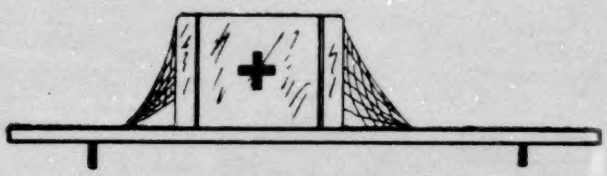
SAFETY POSTERS

YOU CAN SEE THE DIFFERENCE...

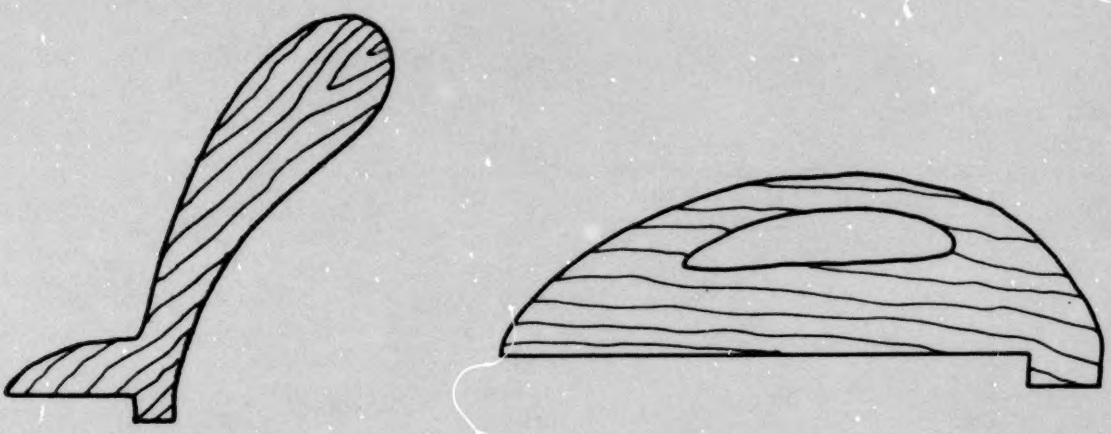


YOU SEE?

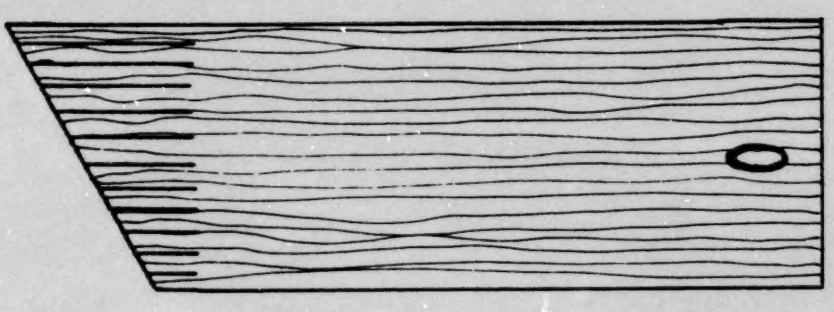
THE BEST FIRST AID KIT



IS ONE THAT'S NEVER NEEDED



PUSH STICKS



FEATHER OR FINGER BOARD

6

Introduction to Wood Processing

OBJECTIVES

After the students have covered the material in this unit, they should be able to—

1. identify common hand tools;
2. identify common machine tools;
3. explain what the hand tools can be used for;
4. explain what the machine tools can be used for; and
5. explain the precautions necessary for safe operation of hand tools and machine tools.

KEY WORDS: VOCABULARY

The words listed below may be new to the student studying woodworking. Instructors should help students understand these words as they are used in this topic of study.

ripping
crosscutting
blade set
kerf
drilling/boring
saw
plane
clamp

TEACHING AIDS

- Overhead projector
- Examples of following hand tools:

ripsaw
crosscut saw
back saw
coping saw
keyhole/compass saw
block plane
smooth plane
jack plane
rabbet plane
spokeshave
files
rasp
hand scraper
claw hammer
nail set
screwdrivers
spiral-ratchet screwdriver
brace
hand drill
push/automatic drill
twist drill
auger bit
expansion bit
counter sink
plug cutter
chisel

- Examples of clamping tools:

C-clamps
spring clamps
corner clamps
parallel or hand clamps
belt or web clamps

three-way clamps
bar or cabinet clamps
pipe clamps

- Test Key: 1-C, 2-A, 3-B, 4-D, 5-C, 6-A, 7-B, 8-B, 9-C, 10-A, 11-D, 12-B, 13-D, 14-A, 15-B, 16-D, 17-C, 18-B, 19-D, 20-C

- Transparencies: You will find transparencies W6-1 through W6-7 at the end of this unit. If you wish, these masters may be duplicated in quantity and given to the students as handouts while they are studying different aspects of this unit.
  W6-1: Hand Saw Terminology
  W6-2: Special-purpose Saws
  W6-3: Planes
  W6-4: Boring Tools
  W6-5: Clamping Tools
  W6-6: Power Tools
  W6-7: Power Tools (continued)

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Feirer, J.L. Cabinetmaking and Millwork. Peoria, Ill.: Bennett Publishing Company, 1982.

Hammond, J.J.; Donnelly, E.T.; Harrod, W.F.; and Rayner, N.A. Woodworking Technology. Bloomington, Ill.: McKnight Publishing Company, 1980.

Hutchings, G.R.; Martin, G.E.; and Coleman, J.M. Working with Wood. Bloomington, Ill.: McKnight Publishing Company, 1982.

Lento, R. Woodworking Tools, Fabrication, Design, and Manufacturing. Englewood Cliffs, N.J.: Prentice-Hall, 1979.

SENTENCE OUTLINE

Section I deals with hand tools and section II deals with machine tools. It is important for students to understand the proper use and limitations of each hand and machine tool they will use.

I. Hand tools
  A. The layout tools covered in Unit 4:
    1. bench rules
    2. rulers
    3. folding or zigzag rulers
    4. tape measures
    5. combination square
    6. try square
    7. framing or carpenters square
    8. sliding T-bevel
    9. pencils
    10. marking gauge
    11. chalk lines
    12. scratch awl
    13. compass
  B. Handsawing tools are used to cut wood with the grain (ripping) or at an angle to the grain (crosscutting). A saw blade's teeth are alternately bent or **set** to provide clearance for the saw blade. This prevents the saw blade from binding during cutting. The cut or groove made by the saw teeth is known as the kerf. (Transparency W6-1)

1. Ripsaws are used for making straight cuts in wood parallel to the grain. They have few teeth per inch (4-7) and make a rough cut fast. (Transparency W6-2)
2. Crosscut saws have more teeth per inch than ripsaws. The teeth are sharp and are used to tear the grain as they cut.
3. Backsaws are crosscut saws used for accurate cutting. They have a strong steel rib across the saw's back. This prevents the saw blade from bending during cutting.
   a. The dovetail saw is a small backsaw used to make fine cuts for joinery.
   b. The miter saw is a large backsaw used to make large accurate cuts.
4. A coping saw consists of a thin blade and a steel frame. It works well when cutting curves or irregular shapes in thin wood.
5. Keyhole and compass saws are used to cut curves and irregular shapes in wood. They are often used in thicker wood or to cut places that a coping saw cannot reach.

C. Smoothing and shaping tools consist of a sharp blade and are often used to smooth wood after sawing, reduce the wood's thickness, true a wood surface, or square stock. (Transparency W6-3)
1. A block plane is small and is usually operated with one hand. It is the best plane to use when planing end grain and is often used to fit and/or smooth furniture trim.
2. A smooth plane is about 9 inches long and is operated with two hands. It is used for final smoothing and works well on short pieces of stock.
3. A jack plane is about 15 inches long and considered to be an all-purpose plane. It can be used for both rough and finish work.
4. A rabbet plane is a specialty plane that is used to cut rabbet joints parallel to the wood grain.
5. The spokeshave plane is used to form or shape irregular designs in wood products.
6. Files come in a variety of shapes and sizes. They are used to remove small amounts of stock, generally to smooth irregular wood surfaces. Files can also be used to smooth metal surfaces.
7. Rasps have large individual teeth compared to files which have rows of small teeth. Rasps are used for rough work. They cut quickly but leave a very rough surface.
8. A hand scraper is a hand-held flat steel blade, which is used to scrape the surfaces of open grained wood.
9. Chisels are very useful tools in woodworking. They consist of a simple steel cutting tool mounted in a handle. They can be used to make wood joints, trim wood, cut irregular surfaces, and make decorative cuts.

D. Fastening tools are used with metal fasteners to secure different pieces of a wood product together. (Wood fasteners are covered in Unit 4.)
1. A claw hammer is used to drive nails into wood. The hammer has a head on one end and a claw on the other to remove nails. Common weights of claw hammers used in woodworking are from 13 to 16 ounces although these hammers can weigh as little as 7 ounces for driving small nails or weigh as much as 20 ounces for carpenters who consistently drive large nails.
2. Nail sets are used to set the heads of finishing nails below the surface of the wood. These holes left by the nail set are later covered with putty during finishing.
3. Screwdrivers are used to set screws into a piece of wood. They come in different sizes depending on the size of the screw used. The standard screwdriver has a flat head and is used with slotted screws. The Phillips screwdriver has a starred tip and is used with Phillips-head screws.
4. Spiral ratchet screwdrivers are used to drive either slotted or Phillips screws quickly into wood.

E. Drilling and boring tools are used to cut round holes into wood. To drill a hole two things are needed. A rotary driving tool and a bit, which will do the cutting. Several hand-operated rotary driving tools and bits are listed. (Transparency W6-4)
   1. A brace is used to hold and drive all types of bits. It can be used with tapered tang bits, screwdriver bits, countersinks, and others. The brace has an offset handle and a ratchet which allows it to be used in tight corners.
   2. A hand drill is used to hold small twist drills for drilling small holes. The drill consists of a chuck and a pinion gear which rides on a circular ring gear. The ring gear is turned by a handle and this in turn drives the pinion gear which turns the chuck.
   3. A push or automatic drill is used to drill small holes with special bits stored in its handle. The handle is pushed down which causes the chuck to turn. A spring pushes the handle back up and the process is repeated.
   4. Twist drills are common drill bits. They have two cutting edges and spiraled flutes to remove the wood chips generated through drilling. Twist drills come in fractional sizes and sets from 1/16 to 1/2 inch, in common increments of 1/32 or 1/64 inch.
   5. Auger bits can be either single or double twisted and come in sizes from 1/4 inch (no. 4) to 1 inch (no. 16). An auger bit has a screw thread on its end which is used to pull the drill bit through the wood.
   6. Expansion bits operate on the same principle as an auger bit. The threaded point pulls the bit through the wood. An expansion bit has an arm that can be adjusted to cut holes from 5/8 inch to 3 inches.
   7. Countersinks are used after a hole is drilled to set flat head screws. The countersink cuts a tapered hole which allows a flat head screw to be drawn up flush to the surface of the wood.
   8. Plug cutters are used to cut plugs to cover screw heads. The screw head must be counter sunk below the surface of the wood in order for the plug to fit over it.

F. Clamping tools are used to hold or apply pressure to stock. Most stock will need to be clamped while an adhesive sets. Clamps are sometimes used to hold stock stationary as different operations are performed. (See Unit 4 for more information about adhesives.)
   1. C-clamps consist of a piece of metal formed into the shape of a C with a screw thread adjustment. These clamps work well for clamping small items or holding stock in place. (Transparency W6-5)
   2. Spring clamps are small light-duty clamps used to clamp small work.
   3. Corner clamps are specially designed to clamp pieces of wood together forming a 90° angle. They work well when clamping miter joints.
   4. Parallel or hand clamps consist of two wooden jaws controlled by two threaded spindles with handles on the ends. They are very versatile and can be adjusted to a wide range of angles to clamp flat or uneven work.
   5. Belt or web clamps are designed to clamp square, round, and oddly shaped objects. These clamps consist of a cloth band and a band clamp used for tightening.
   6. Three-way clamps are used to attach edge banding to wood. These clamps have a heavy steel frame with three adjustable screw threads.
   7. Bar or cabinet clamps are commonly used to clamp narrow pieces of wood into wider panels. They are also used to clamp products together. Bar or cabinet clamps are made of a heavy strip of metal with an adjustable stop on one end and a screw clamp on the other.
   8. Pipe clamps are similar to bar or cabinet clamps. They use a pipe instead of a heavy steel bar to which the adjustable stop and screw clamp are attached.

II. Woodworking power machines (Transparencies W6-6 and W6-7)

A. Power woodworking machines can save time compared to hand tools. Power machines often operate at high speed and use sharp blades and knives in their operations. It is very important that one not operate a piece of power woodworking equipment without proper instruction and the supervision of an instructor.

B. A radial arm saw is a very versatile saw, although it is primarily used to crosscut stock to length. It can also be used to rip stock. Attachments can be added to make it into a router, disc sander, horizontal boring machine, and so forth.
   1. The size of a radial arm saw is determined by the maximum diameter blade specified by the manufacturer.
   2. Radial arm saws come in two styles. One style has the arm pivot in the back of the machine and the other style has the arm pivot in the middle of the over arm.
   3. The arm can be pivoted, with the motor, to cut angles and compound angles.
   4. Stops can be placed on the fence to cut duplicate parts.
   5. Safety - The radial arm saw is difficult to fit with an effective guard. Therefore, it is extremely important to keep hands away from the blade.
      a. Be sure the arm lock is set on the saw before starting.
      b. Loosen the lock after saw is started; place one hand on the handle and the other hand holding the wood in place (at least 56 inches from blade).
      c. Slowly allow the saw to cut through the wood.
      d. Return the saw to its original position after making the cut; lock the arm and turn the motor off.

C. A circular or table saw consists of a table with rip fence and miter gauge. A handle for raising and lowering the blade is usually located in front of the saw. A handle for tilting the blade is usually located on the side.
   1. The size of the saw is determined by the largest diameter saw blade recommended by the manufacturers.
   2. The saw can be used for ripping, and cutting rabbets, grooves, and edge cut miters when using the rip fence.
   3. End cut miters, square cuts, and dados can be made using the miter gauge.
   4. Safety - kickback is a serious problem with the circular or table saw if the machine is not used properly. Always use the saw guard.
      a. Be sure to use the rip fence as a guide when ripping boards. Make sure boards to be ripped are as long as the diameter of the blade.
      b. Use a feather board and push sticks when ripping narrow stock. (Transparency W5-2)
      c. Use the miter gauge when crosscutting.
      d. Use a stop block when using the fence as a stop with the miter gauge to cut duplicate parts.
      e. Do not stand directly behind the sw.

D. Major parts of the jointer are the infeed and outfeed tables, fence, cutterhead, and table-adjusting wheels. The jointer is primarily used to condition wood prior to surfacing or to smooth the edges of stock.
   1. The size of a jointer is determined by the length of its knives.
   2. Safety
      a. Joint wood that has at least 12 inches of contact with the table.
      b. Standard cut is 1/16 of an inch.
      c. Remove warp from a board joint with cup side down using push sticks. Then joint best edge with its face against the fence.
      d. Jointing end grain is not recommended because of the poor quality of cut. Crosscut boards to length using the table saw or radial arm saw.

E. A surfacer or planer is used to plane wood to thickness. A surfacer or planer cannot remove warp from a board unless one face has been conditioned on the jointer.

1. The size of a surfacer or planer is determined by the length of its blade.
2. One turn on the adjusting wheel raises or lowers the bed 1/16 of an inch.
3. Safety
   a. Standard cut is 1/16 of an inch.
   b. Do not stand directly behind the machine when it is running.
   c. Boards must be over 12 inches long to pass safely through the machines.
   d. Boards under 3/8 inch in thickness must be run through the machine on top of a thicker piece of stock (piggy back).

F. A wood lathe is used to produce turned or round parts. The lathe consists of a headstock, tail stock, tool post holder, tool rest, and a means of varying the speed of the lathe.
1. A wood lathe's size is determined by the maximum diameter of a piece of stock that can be turned on the inboard side of the lathe.
2. Common tools used on the lathe are the gauge, round nose, spear point, skew, and parting tool.
3. Turning can be done:
   a. Between centers (spur center and tail center)
   b. Using a face plate
4. Small diameter stock can be turned inboard while large diameter stock is turned outboard.
5. Safety
   a. Always use the guard.
   b. Turn at the correct speed for the size of the stock and operation being performed.
   c. Always use good defect-free wood and be sure all glue joints are sound.
   d. Position the tool rest slightly above the center of the stock and 1/8" away from it.

G. A drill press is used for drilling or boring holes in wood. Two types exist, a bench model and a floor mounted model. The major parts of a drill press are the base, column, table, drill press head, and chuck.
1. The size of a drill press is determined by the distance from the center of the drill to the column.
2. The drill press can be used for precision drilling necessary for installing dowel pins or semi-precision drilling for screw holes.
3. Safety
   a. Be sure not to wear jewelry or loose clothing or have long hair hanging down that might get caught in the revolving parts of the drill press.
   b. Select the proper speed to run the drill press. Remember the larger the drill bit, the slower the drill speed.
   c. Clamp small work firmly to the table before drilling.

H. Sanding machines are generally used as part of the finishing operation. These machines use abrasives such as garnet, aluminum oxide, and silicon carbide to wear away the surface of wood. Sanding machines come in a variety of shapes and sizes depending on their function.
1. A finishing sander is usually portable and has a finishing pad size of $4\frac{1}{2}$ x 11 inches or smaller. These sanders have either a straight line motion, orbital, or multi-motion action.
2. A belt sander can be stationary or portable. It consists of a belt that is driven by a motor. These machines are used for rapid material removal.
3. A disk sander is a stationary tool and is generally used on end grain or the edge of a piece of wood. The disk sander has limited use because only the downward rotating half of the disk can be used and the outside edge of the disk is revolving faster than the inside. This causes material to be removed unequally.
4. A spindle sander uses round abrasive sleeves and is very useful in sanding curved surfaces.

5. Safety
   a. Wear a dust mask if a lot of sanding is to be done or if the dust bothers you.
   b. Be careful not to run over the cord when using the portable belt sander.
   c. Keep hands, clothing, and jewelry away from any revolving parts of sanding machines.

I. Other saws
   1. A jigsaw uses narrow blades and works well when making irregular or curved cuts in thin stock.
   2. A saber or bayonet saw is portable and is used for operations similarly performed by the jigsaw.
   3. A band saw can cut irregular curves, and circles, and make straight cuts much like the jig or saber saw. It has an advantage over the other two saws because its blade revolves in a circle and does not travel in an up-and-down manner.
      a. The band saw size is determined by the size of its drive wheel.
      b. The band saw can be used for ripping using the rip fence, crosscutting using the miter gauge, and resawing using the rip fence or pivot block.
      c. Large circles can be accurately cut using a circle jig.
      d. Irregular and curved cuts can be made free hand. Relief cuts must be made on tight curves.
   4. Safety
      a. Be sure the stock in the jig, band, or saber/bayonet saw is moving forward as it is turned to make curved cuts. This prevents blade breakage.
      b. Never back out of a curved cut while the bandsaw is in operation. This can cause the blade to be pulled out of its guides.
      c. Inform the instructor if a blade breaks.

J. Portable electric routers are extremely high speed machines (operating at 2,000-28,000 rpm) and are very useful tools for woodworking.
   1. Edge-cutting bits can be used to cut decorative edges. A bearing is found at the bottom of these bits and is used to follow the edge of the board.
   2. Rabbeting, dados, grooves, veining, and other operations are generally directed along the edge of a guide board or used with guides that come with the router.
   3. The size of a router is determined by the horsepower of the motor and the maximum size collet the router will hold.
   4. Router bits are changed by locking the armature and loosening the collet nut.
   5. Safety
      a. Be sure the router bits are sharp before using the router.
      b. Be sure to travel in the proper direction with the router (counter clockwise when routing the outside edges and clockwise when routing a cutout in the middle of a piece of stock).
      c. When using a guide, be sure the router is traveling in the correct direction so the bit is not pushing the router away from the guide.

K. The portable electric drill is one of the most common and useful tools in the woodworking laboratory. (Transparency W6-4)
   1. Portable electric drills come in sizes according to the maximum recommended diameter drill bit the chuck will hold. Many electric drills have a variable and reversing feature on them.
   2. Portable electric drills can be used to drill holes and drive screws. With various attachments, they can be used as a disk or drum sander.
   3. Safety
      a. Be sure to remove the chuck key prior to using.
      b. Be sure no loose clothing, jewelry, or hair will get caught in the revolving chuck.

MATERIALS FOR STUDENTS

- Vocabulary worksheet
- Handouts
- Examples of hand tools
- Practice blocks of wood for use with hand tools
- Paper, pencils, and other drawing equipment to use in designing, and developing a bill of materials and a procedure sheet for a product
- Materials from which students may build a hand tool product
- Examples of machine tools
- Practice blocks to be used with machine tools
- Drawing equipment to design and plan a machine tool product
- Materials with which to build a machine tool product

SUGGESTED STUDENT ACTIVITIES

1. Identify and explain what the following hand tools are used for:
   a. measuring tools
   b. hand saws
   c. hand planes
   d. fastening tools
   e. drilling and boring tools
   f. clamping tools
2. Demonstrate how to use the above tools correctly.
3. Have students practice using the above tools on a practice block of wood.
4. Have students design and build a hand tool product that conforms to specifications. Example: Design, properly plan, and build a box to store 5" x 8" index cards. (Unit 4: Designing, Joining, Planning, and Material Layout, may be helpful.)
5. Identify and explain uses for the machine tools students will be allowed to use.
6. Demonstrate the safe and proper use of machine tools.
7. Have students practice the safe use of machine tools on a practice block.
8. Have students design and build a machine tool product.
9. Have students form a company and mass produce a product using hand and/or machine tools. (Unit 2: Laboratory Management, may provide additional information.)
10. Have students work together on a AIASA group project such as building a soap box racer for state competition.
11. Develop a laboratory organization procedure to insure the laboratory is efficiently run. Methods for checking-in tools and cleaning the laboratory should be included.

Vocabulary Worksheet

1. ripping

2. crosscutting

3. blade set

4. kerf

5. drilling/boring

6. saw

7. plane

8. clamp

TEST

Unit 6: Introduction to Wood Processing

Directions: Read each statement carefully. Select the one word or phrase that correctly answers or completes the statement, and write the appropriate letter in the blank provided.

Example: D 21. The class you are in is—
A. Science
B. English
C. Art
D. Industrial Technology

___ 1. What hand saw has a heavy metal rib along its back and is used for accurate straight line sawing operation?
A. rip saw
B. coping saw
C. back saw
D. keyhole saw

___ 2. What hand saw has a frame and uses a thin blade to make curved cuts?
A. coping saw
B. back saw
C. cross cut saw
D. keyhole saw

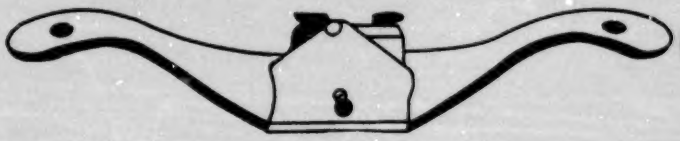
___ 3. A rip saw has _____ as compared to a cross cut saw?
A. more and smaller teeth
B. fewer and larger teeth
C. fewer and smaller teeth
D. the same size and number of teeth

___ 4. Which hand plane can be operated with one hand and can be used for planing end grain?
A. rabbet
B. jack
C. smooth
D. block

___ 5. Which plane is about 15 inches long and can be used for both rough and finished work?
A. rabbet
B. smooth
C. jack
D. block

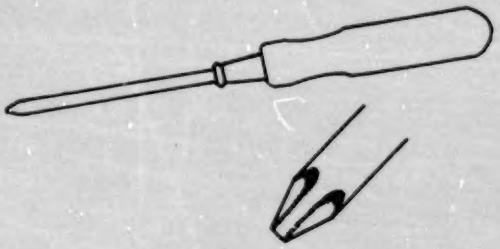
___ 6. Which hand tool can be used to shape both wood and metal?
A. file
B. rasp
C. spokeshave
D. hand scraper

___ 7. Identify the tool to the right.
A. chisel
B. spokeshave
C. hand scraper
D. file



___ 8. What tool is used to sink a finishing nail head below the surface of a piece of wood?
A. Phillips screwdriver
B. nail set
C. rasp
D. brace

___ 9. Identify the tool to the right
A. spiral ratchet
B. claw hammer
C. Phillips screwdriver
D. standard screwdriver



___ 10. This hand drill has a bent handle and a ratchet and can be used with a bit for drilling holes.
A. brace
B. hand drill
C. automatic drill
D. twist drill

___ 11. This drill bit can be adjusted to cut holes from 5/8" to 3" in size. It has a screw thread point and is used in a brace.
A. countersink
B. auger bit
C. twist drill
D. expansion bit

___ 12. This clamp is extremely useful when clamping mitered corners together.
A. parallel or hand clamps
B. corner clamps
C. C-clamps
D. bar clamps

___ 13. This clamp is long and commonly used to clamp narrow pieces of wood together into large panels.
A. parallel or hand clamps
B. corner clamps
C. three-way clamps
D. bar or cabinet clamps

___ 14. This power woodworking machine is used to give wood two parallel surfaces and to reduce its thickness.
A. planer/surfacer
B. radial arm saw
C. jointer
D. table saw

___ 15. This saw has a metal table and a circular blade and can be used for ripping when using the rip fence and crosscutting when using the miter gauge.
A. band saw
B. table saw
C. radial arm saw
D. jigsaw

___ 16. This saw has a narrow blade and cuts with an up-and-down motion. It works well for cutting curves on thin stock.
A. radial arm saw
B. band saw
C. table saw
D. jigsaw

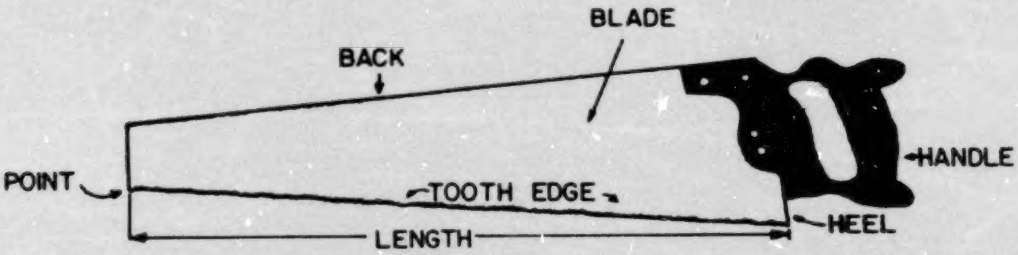
___ 17. Kickback is a serious safety problem on which saw?
A. radial arm saw
B. band saw
C. table saw
D. jigsaw

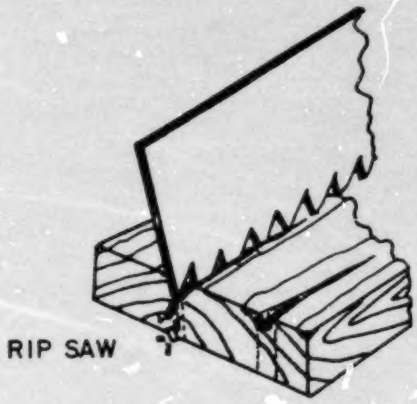
___ 18. The size of a radial arm saw is determined by the maximum—
A. thickness of wood it can cut
B. recommended size of blade for the saw
C. width board that can be cut
D. length board that can be cut

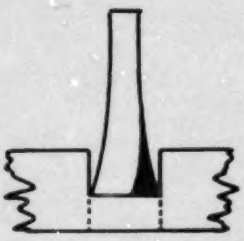
___ 19. Which sanding machine can remove stock the fastest from the face of a piece of wood?
A. disk sander
B. drum sander
C. finish sander
D. belt sander

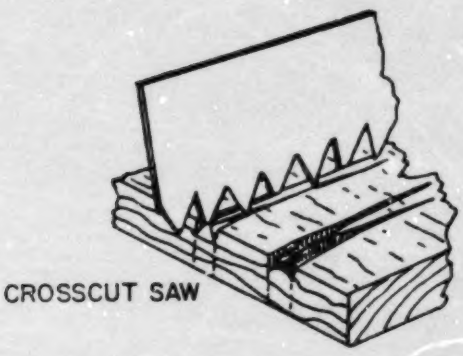
___ 20. What portable power tool operates at a high rpm (20,000-28,000) and can be used to cut dados and rabbets, and make decorative cuts on the edge of a piece of stock?
A. electric drill
B. saber saw
C. router
D. band saw

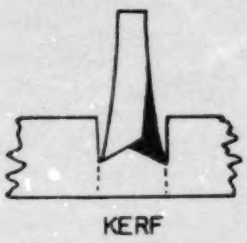
HAND SAW TERMINOLOGY









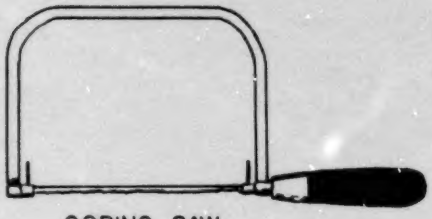


SPECIAL-PURPOSE SAWS

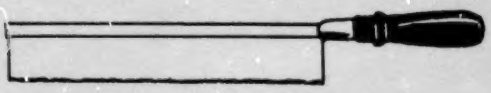
HACK SAW

BACK SAWS

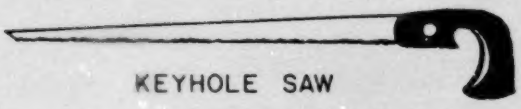
BACK SAW



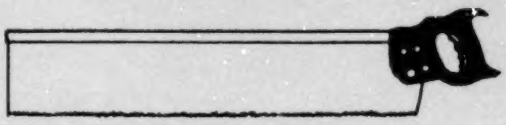
COPING SAW



DOVETAIL SAW



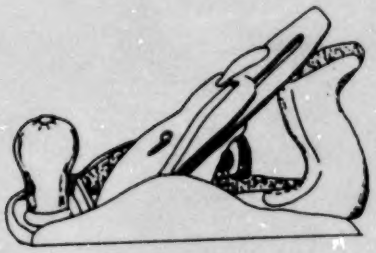
KEYHOLE SAW



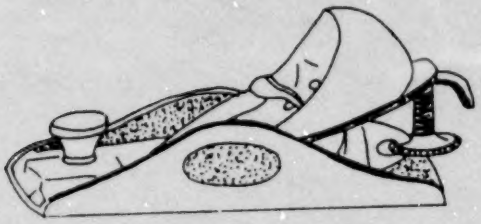
MITER BOX SAW

PLANES

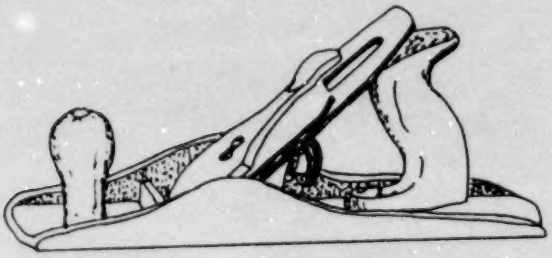
COMMON PLANES



SMOOTH PLANE

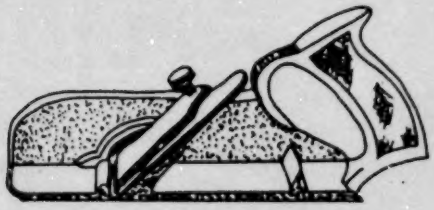


BLOCK PLANE



JACK PLANE

SPECIALIZED PLANES

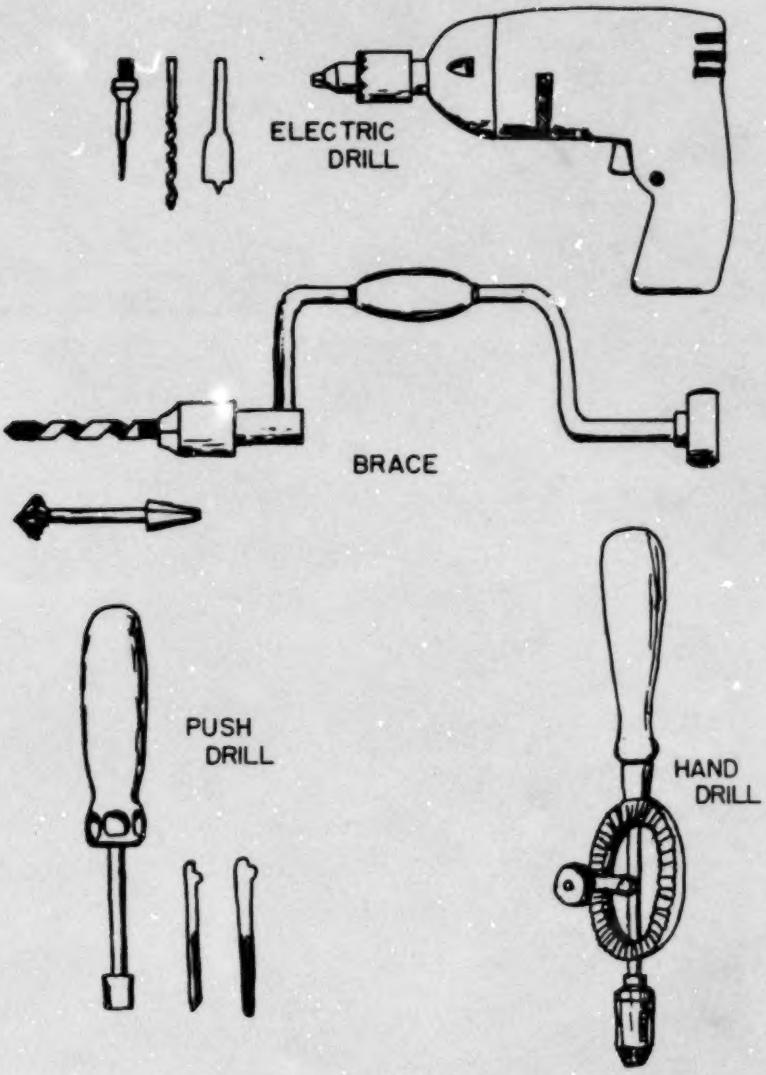


IRON RABBET PLANE

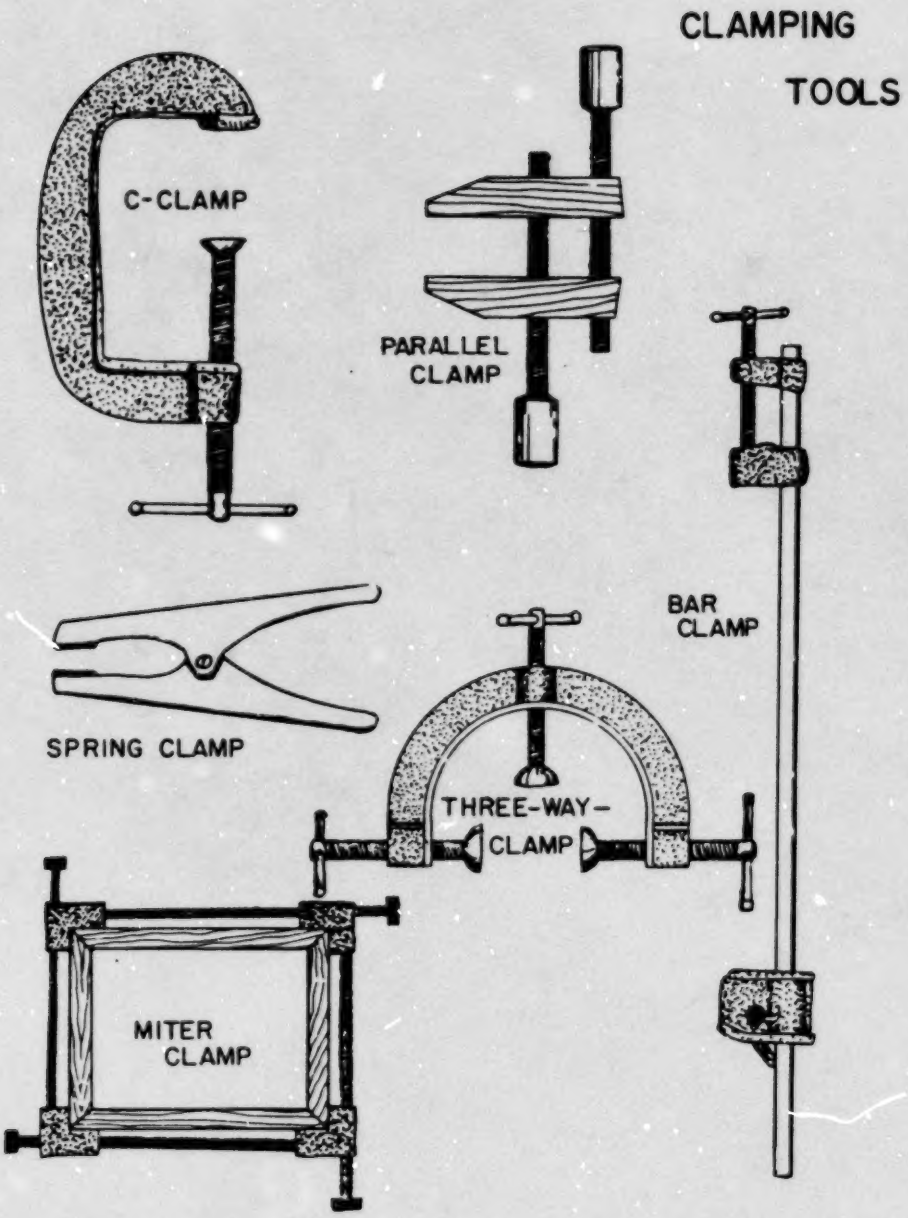
SPOKESHAVE

ROUTER PLANE

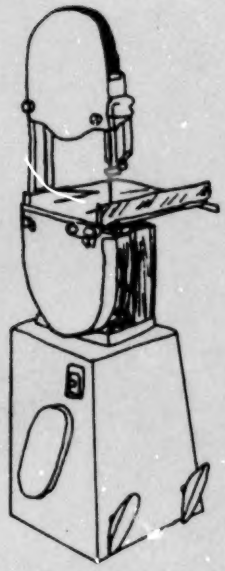
BORING TOOLS



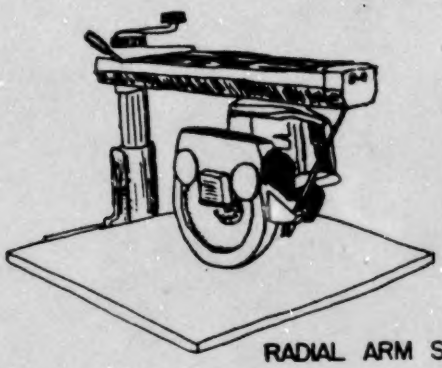
CLAMPING TOOLS



POWER TOOLS



BANDSAW



RADIAL ARM SAW

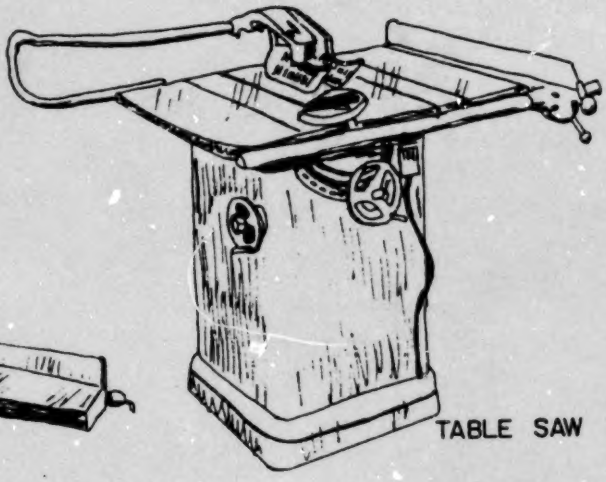
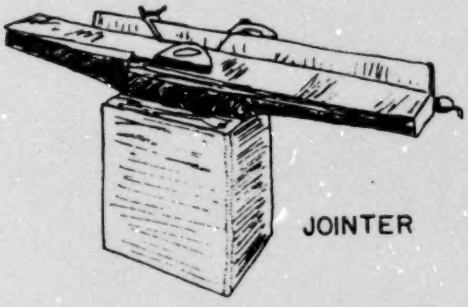
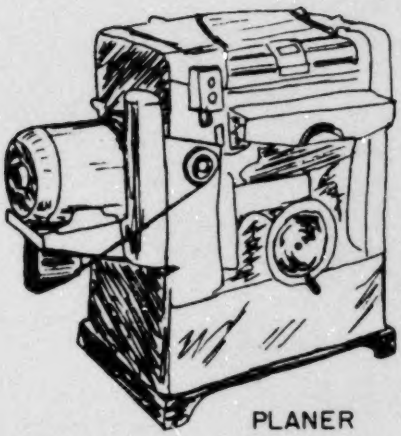


TABLE SAW

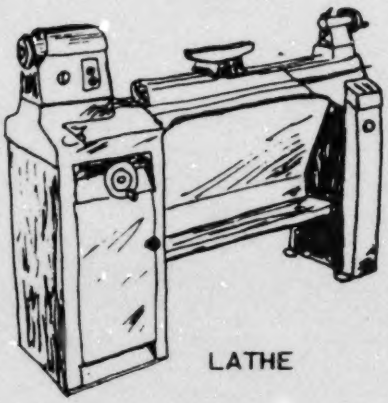


JOINTER

POWER TOOLS (CONTINUED)

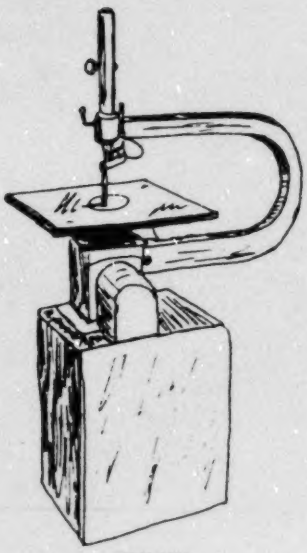


PLANER



LATHE

DRILL PRESS



JIGSAW

BELT SANDER

7

Wood Finishing

OBJECTIVES

After the students have covered the material in this unit, they should be able to—

1. describe the purpose of a finish;
2. distinguish a penetrating oil finish from a surface finish;
3. properly prepare a surface for a finish;
4. identify common wood repair materials;
5. describe different kinds of stains;
6. describe different methods of applying a finish; and
7. list a finishing schedule for a penetrating oil and for a surface finish.

KEY WORDS: VOCABULARY

The words listed below may be new to the student studying wood finishing. Instructors should help students understand these words as they are used in this topic of study.

finish
penetrating oil
surface finish
putty stick
wood dough
lacquer stick
dye
pigment
stain
wood filler
lacquer
polyurethane
oil varnish
brush
spray gun
runs and sags
orange peel
finishing schedule

TEACHING AIDS

- Overhead projector
- Finished wood samples
- Examples of finishing products
- Test Key: 1-D, 2-A, 3-C, 4-D, 5-C, 6-D, 7-C
- Transparencies: You will find transparencies W7-1 and W7-2 at the end of this unit. If you wish, these masters may be duplicated in quantity and given to the students as handouts while they are studying different aspects of this unit.
  W7-1: Types of Finishes
  W7-2: Spraying

SUGGESTED REFERENCES

Feirer, J.L. Cabinetmaking and Millwork. Peoria, Ill.: Bennett Publishing Company, 1982.

Hutchings, G.R.; Martin, G.E.; and Coleman, J.M. Working with Wood. Bloomington, Ill.: McKnight Publishing Company, 1982.

Soderberg, G.A. Finishing Technology. Bloomington, Ill.: McKnight Publishing Company, 1969.

SENTENCE OUTLINE

I. Introduction
   A. Finishes are applied to wood for two main reasons:
      1. To protect the wood from such things as dirt, abrasion, and moisture.
      2. To enhance the beauty of the wood.
   B. Finishes applied to wood for indoor use fall into two major categories:
      1. Penetrating finishes
      2. Surface finishes

II. Surface preparation is an important step prior to applying a finish.
   A. Carefully sand the surface, first with a coarse grit paper (60-100 grit) and proceed to a fine grit paper (120-180 grit).
      1. The final sanding of open grain woods such as walnut, oak, and ash can be done with 120-150 grit abrasives.
      2. The final sanding of close grain woods like cherry, poplar, maple, and softwoods must be done with the higher 150-180 grit abrasives.
   B. Defects such as dents or gaps in joints must be repaired.
      1. Small dents can be repaired by steaming. Place a damp rag over the defect and heat with an iron.
      2. Plastic wood or wood dough can be used to fill cracks.
      3. Lacquer sticks can be melted into cracks and other defects.
      4. Putty sticks can be used to repair small cracks and cover nail heads after a product is finished.

III. Penetrating oil finishes
   A. Modern penetrating oils are a blend of several oils. Common brand names for these finishes include Watco, Minwax, and Deftco.
   B. These finishes penetrate into the wood about 1/16 inch.
   C. Penetrating oils set up through the process of polymerization. This process involves the combining of small molecular chains into large molecular chains.
   D. Penetrating oils harden the surface of wood up to 25% and from a moisture-resistant barrier.
   E. Penetrating oils are easy to apply and require no special equipment. A rag or brush can be used to apply the finish.
   F. Dyes can be added to penetrating oils to add color.
   G. A common finishing schedule for penetrating oils is as follows:
      1. Prepare the surface.
      2. Apply a coat of oil. Allow to stand for 15 minutes. The remove the extra and let dry.
      3. Apply a second coat of oil. While surface is wet, sand with 320 wet/dry paper to remove small fibers of wood. Let stand 15 minutes. Remove extra oil with a rag and let dry.
      4. Apply a third coat of oil. Let stand 15 minutes. Remove extra oil with a rag and let dry.
      5. Optional: Apply a coat of liquid self-polishing wax.
   H. The preceding finishing schedule is a representative example. Be sure to follow manufacturer's instructions.
   I. Caution: Store oily rags in an airtight container or a jar containing water to prevent a fire from starting by spontaneous combustion.

IV. Surface finishes are the most widely used finishes in commercial woodworking.
   A. Surface finishes are applied to build up a protective film on the surface of a piece of wood.
   B. Surface finishes can be clear finishes such as lacquers, polyurethanes, or oil varnishes. When a pigment is added to these surface finishes, they become a paint.
      1. Lacquers are fast-drying surface finishes composed mainly of nitrocellulose. They are best applied by spraying, but with care they can be brushed or rolled. The solvent used for lacquers is lacquer thinner.
      2. Polyurethanes are modern plastic finishes which are easy to brush on. These finishes are exceptionally durable and water resistant. They can be brushed, rolled, or sprayed. The solvent used for polyurethanes is mineral spirits/paint thinner.
      3. Oil varnishes have largely been replaced by lacquers and polyurethanes. These oil varnishes consist of an oil and resin and can be brushed, rolled, or sprayed. The solvent used for oil varnishes is mineral spirits/paint thinner.
   C. Stains can be applied to wood before finishing it to: unify the color of the wood, imitate more expensive wood, or provide decoration.
      1. Oil pigmented stains consist of an oil plus a pigment. They are brushed, wiped, or sprayed on and the extra removed with a rag.
      2. Oil stains consist of an oil and a dye. They have less hiding ability than oil pigmented stains. They are brushed, wiped, or sprayed on with the extra removed with a rag.
      3. Glazing stains are special stains that are used over a sealed surface to produce decorative effects.
   D. Wood fillers or stain fillers are made to fill the pores of open grain woods such as oak and walnut. These fillers are extremely heavy bodied and are applied with a brush. After about 15 minutes, the filler is removed by rubbing across the grain with burlap. Then a protective coating is added.
   E. Brushes are important to good quality finishes. The most common bristle used in modern brushes is nylon. Brushes must be cleaned after each use, using the proper solvent. After cleaning, the brushes should be wrapped to prevent the bristles from flaring outward.
   F. Rollers are used to apply a finish to large flat surfaces. Special rollers are available to produce a textured finish. Generally, rollers are disposed of after each use.
   G. Spraying is a fast and efficient way to apply a finish to a flat or irregular surface. Spraying requires several pieces of specialized equipment:
      1. A spray booth is desirable to collect the oversprayed material and to exhaust vapors from the room.
      2. An air compressor is needed to supply compressed air.
      3. An air transformer removes dirt, oil, and moisture from the air and regulates the air pressure going to the spray gun.
      4. The spray gun is the heart of a spraying system and is used to apply the finish. Two basic types of spray guns exist: the suction feed type and the pressure feed type, both of which can have either an internal mix or external mix nozzle. The most common spray gun in school laboratories is the suction feed, external mix gun.
      5. A spray should be held from 6 to 8 inches from the work and moved in a straight line being sure not to arc the gun.
      6. Overlap strokes to eliminate the possibility of streaks or missed areas and to eliminate the need for a second coat.
      7. Common problems encountered when spraying are runs and sags from applying the finish too thickly. This defect is usually caused by spraying too close to the work, traveling too slowly with the gun, or adding too much thinner to the finish. Orange peel is another common finishing defect caused by spraying too

far away from the work, traveling too fast, or not adding enough thinner to the finish.

V. Common surface finish schedule:
   A. Prepare the surface.
   B. Optional: Apply a stain or stain filler.
   C. Apply a sealer. Sand lightly with 320 grit paper after drying.
   D. Apply a top coat. Let dry.
   E. Apply a second top coat. Let dry.
   F. Optional: Apply a wax.

MATERIALS FOR STUDENTS

- Vocabulary worksheet
- Experimental finishing block (can be made from small pieces of wood or cut from 1/4" plywood)
- Finishing materials

SUGGESTED STUDENT ACTIVITIES

1. Demonstrate the proper surface preparation of a piece of wood prior to finishing.
2. Demonstrate the proper method of repairing defects in wood surfaces.
3. Demonstrate the proper application of a penetrating oil.
4. Demonstrate the proper application of a surface finish.
5. Practice finishing on practice blocks.
6. Select and properly apply a wood finish to a product.

Vocabulary Worksheet

1. finish

2. penetrating oil

3. surface finish

4. putty stick

5. wood dough

6. lacquer stick

7. dye

8. pigment

9. stain

10. wood filler

11. lacquer

12. polyurethane

13. oil varnish

14. brush

15. spray gun

16. finishing schedule

17. runs and sags

18. orange peel

TEST

Unit 7: Wood Finishing

Directions: Read each statement carefully. Select the one word or phrase that answers the question or completes the statement correctly. Write the appropriate letter in the blank provided.

Example: __D__ 21. The class you are in is—
A. Science
B. English
C. Art
D. Industrial Technology

___ 1. Finishes are applied to wood for the purpose of—
A. protecting the wood from dirt, abrasion, and moisture
B. making a wood product stronger
C. enhancing the beauty of the wood
D. both A and C

___ 2. The repair material that comes in a crayon form and is used to repair small cracks or to cover nail heads is known as—
A. putty sticks
B. plastic wood
C. lacquer sticks
D. wood wax

___ 3. The type of finish that goes into the wood about 1/16", sets up by polymerization, and does not build up a surface film is—
A. polyurethane
B. lacquer
C. penetrating oil
D. varnish

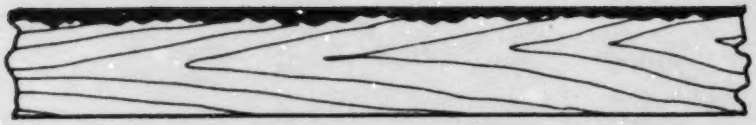
___ 4. Mineral spirits/paint thinner is the solvent for—
A. lacquer
B. polyurethane
C. oil varnish
D. both B and C

___ 5. The finishing material that can be used on open grain wood such as oak to fill the pores is—
A. oil stain
B. oil pigmented stain
C. wood filler
D. glazing stain

___ 6. The following are common spraying defect(s)—
A. brush marks
B. orange peel
C. runs and sags
D. both B and C

___ 7. How many inches from the surface to be sprayed should the spray gun be held?
A. 2 to 4
B. 4 to 6
C. 6 to 8
D. 10 to 12

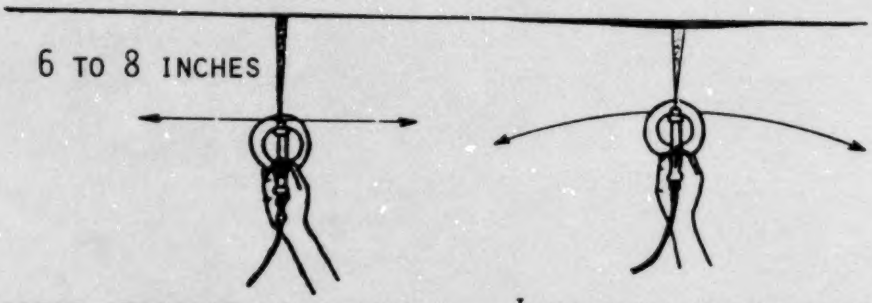
TYPES OF FINISHES



PENETRATING STAIN

SURFACE FINISH

SPRAYING

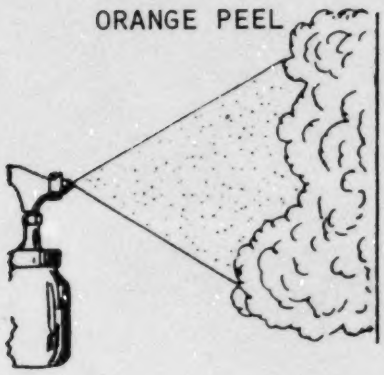


CORRECT STRAIGHT LINE MOTION

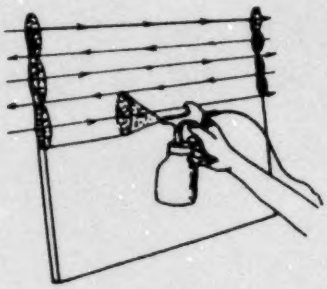
INCORRECT ARCHING MOTION

RUNS AND SAGS

ORANGE PEEL



CORRECT HORIZONTAL SPRAYING PATTERN



CORRECT VERTICAL SPRAYING PATTERN

8

Careers in the Woodworking Industry

OBJECTIVES

After students have covered the material in this unit, they should be able to—

1. explain the term career;
2. explain the type of training needed for jobs in the following classifications:
   a. unskilled
   b. semiskilled
   c. skilled
   d. semiprofessional
   e. professional;
3. list the personal characteristics that should be considered when selecting a career;
4. describe the importance of education in pursuing a career; and
5. give examples of careers in each of the five career classifications listed in objective two.

KEY WORDS: VOCABULARY

The words in the following list may be new to the student studying woodworking. Teachers should help students understand these words as they are used in this topic of study.

career
unskilled
skilled
semiprofessional
professional

TEACHING AIDS

- Overhead projector
- Test Key: 1-A, 2-C, 3-D, 4-C, 5-C

SUGGESTED REFERENCES

Hutchings, G.R.; Martin, G.E.; and Coleman, J.M. Working with Wood. Bloomington, Ill.: McKnight Publishing Company, 1982.

Miller, W.R., and Zook, W.H. Woodworking. Bloomington, Ill.: McKnight Publishing Company, 1978.

SENTENCE OUTLINE

I. Introduction
   Career exploration is extremely important for students. Fulfillment in life is often related to a satisfying career. No single endeavor in a person's life will occupy more time than a career. It is important that students begin to look at career opportunities early in their schooling so they can begin to prepare for the world of work.

II. Five categories of careers depend upon the education and skills required.
   A. Unskilled—little on-the-job training
   B. Semiskilled—on-the-job training

C. Skilled—vocational apprenticeship and/or on-the-job training
D. Semiprofessional—generally a college education, junior college or technical training
E. Professional—generally a college education is required plus work experience

III. General information
A. A career consists of a series of jobs that last through a person's adult life.
B. A career should be carefully selected based on a person's:
1. Abilities
2. Interests
3. Personality
4. Financial needs
5. Physical makeup
C. Education is important in the pursuit of a career.
1. Math is important in solving problems with numbers.
2. Communication skills such as reading, writing, and speaking are necessary for almost every job.
3. Research skills are important for people to find answers to problems on their own.
4. Motivation is the self-drive a person must have in order to get a job done.

IV. Examples of careers in the forest products area:
A. Unskilled jobs require little training.
1. Laborer at a construction site
2. Materials handler at a lumber yard
B. Semiskilled jobs require on-the-job training.
1. Cabinet or furniture production line worker
2. Machine operator
C. Skilled workers often go through an apprenticeship program to learn their skills.
1. Cabinetmaker
2. Carpenter
3. Patternmaker
D. Semiprofessional workers gain their knowledge in school and on the job.
1. Furniture salesperson
2. Drafter who prepares drawings
3. Lumber salesperson
E. Professional jobs usually require a college degree.
1. Architects design buildings.
2. Engineers develop new wood products.
3. Foresters manage forest areas and determine what trees to cut and when to cut them. They also plant trees to replace those that are cut.
4. Furniture designers design furniture to be built. These professionals must understand the properties of wood and wood finishes. They must also have a thorough understanding of furniture construction methods.

MATERIALS FOR STUDENTS

- Vocabulary worksheet
- Appropriate reading materials about various careers related to the woodworking industry.

SUGGESTED STUDENT ACTIVITIES

1. Have students research careers they are interested in. This research should include—
   a. types of jobs a person would have during this career;
   b. education or training required;
   c. salary;
   d. physical requirements; and
   e. personality requirements.
2. Have students give presentations to the class on a career of their choice.
3. Invite various individuals to speak about careers they are involved with.
4. Show movies and/or slides on careers.
5. Have students role-play different jobs in a student-run manufacturing enterprise in the woodworking laboratory.

Vocabulary Worksheet

1. career

2. unskilled

3. semiskilled

4. semiprofessional

5. professional

TEST

Unit 8: Careers in the Woodworking Industry

Directions: Read each statement carefully. Select the one word or phrase that answers the question or completes the statement correctly. Write the appropriate letter in the blank provided.

Example: __D__ 21. The class you are in is—
A. Science
B. English
C. Art
D. Industrial Technology

___ 1. Which job classification requires the least amount of training?
A. unskilled
B. semiskilled
C. semiprofessional
D. professional

___ 2. A carpenter or a cabinetmaker falls into the job category of—
A. unskilled
B. semiskilled
C. skilled
D. semiprofessional

___ 3. A college degree is generally required for the—
A. semiskilled
B. skilled
C. semiprofessional
D. professional

___ 4. In which career does a person spend much time outdoors managing forested areas?
A. engineer
B. architect
C. forester
D. furniture designer

___ 5. Which career requires a person to serve an apprenticeship to learn the necessary skills?
A. laborer
B. machine operator
C. cabinetmaker
D. architect

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FMC

FMC Corporation An equal opportunity employer

Application for employment/Hourly Personnel

It is the policy of FMC Corporation to provide equal opportunity for all qualified persons and not to discriminate against any employee or applicant for employment because of age, race, creed, color, sex, national origin, or handicap.

Date

Return completed application to

PERSONNEL DEPARTMENT
FMC CORPORATION
FLUID CONTROL DIVISION
Stephenville Plant
2825 West Washington
P. O. Box 1377
Stephenville, Tx. 76401
817/968-2181

IDENTIFICATION

(Print) FIRST NAME	MIDDLE NAME	LAST NAME	SOCIAL SECURITY NUMBER
LOCAL ADDRESS — STREET AND NUMBER			TELEPHONE
PERMANENT ADDRESS — STREET AND NUMBER			TELEPHONE
ARE YOU A U.S. CITIZEN? IF NO, WHAT TYPE VISA DO YOU HOLD? ☐ YES ☐ NO			
NAME OF PERSON TO BE NOTIFIED IN CASE OF EMERGENCY	CITY	STATE ZIP	TELEPHONE

PREVIOUS EMPLOYMENT

FROM	TO	NAME OF COMPANY	ADDRESS	POSITION	REASON LEFT	WAGE	May We Contact
			STREET _____ CITY_____ STATE_____				
			STREET _____ CITY_____ STATE_____				
			STREET _____ CITY_____ STATE_____				

PREVIOUS EXPERIENCE

CHECK MACHINES YOU HAVE OPERATED

____ Single Spindle Drill Press	____ Engine Lathe	____ Universal Grinder	____ Heat Treat Equipment
____ Multiple Spindle Drill Press	____ Bullard Boring Mill	____ Internal Grinder	____ Lift Truck
____ Radial Drill	____ Automatic Chuckers	____ External Grinder	____ Overhead Crane
____ Automatic Screw Machine	____ Milling Machine	____ Cold Heading Machine	____ Electric Welder
____ Hopper or Gear Cutter	____ Horizontal Boring Mill	____ Punch Press	____ Acetylene Welder
____ Turret Lathe	____ Barnesmatic	____ Swag Grinder	____ Auto. Weld Machine
____ Notching	____ Iron Pouring	____ Core Making	____ Foundry Laborer

OTHER MACHINES OPERATED _____

DO YOU SET UP_____ LAYOUT_____ READ BLUE PRINTS_____ MACHINE DRAWINGS_____ HAVE BASIC TOOLS_____

POSITION DESIRED _____ EARNINGS EXPECTED _____

SHIFT YOU CAN WORK: 1 2 3

STEPHENVILLE PRINTING CO., INC. ****

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Additional Experience

State what you did in any periods not already covered, including part-time or self employment - Additional sheets may be used.

Dates	

EDUCATION

	NAME OF SCHOOL	LOCATION	Dates Attended From	Dates Attended To	Years Credit	Year Grad.	Degree	Course or Major Subject
	High School							
	Business or Trade School							
	College or University							
	Other							

U.S. MILITARY SERVICE

Branch of U.S. Service	Date Entered Month	Date Entered Year	Date Discharged Month	Date Discharged Year	Rank at Discharge	Type of Discharge

Nature of duties and any special training and honors received

Have you ever received a military disability pension? If so, give nature of disability

Present draft, reserve or military status

REFERENCES

NAME (not a relative or employer)	COMPLETE MAILING ADDRESS	OCCUPATION

REMARKS

Have you ever been convicted of, or entered a plea of guilty to a felony?

☐ Yes ☐ No If yes, explain fully

List serious operations, accidents, illnesses, disabilities, and limitations (if none, so state)

Have you ever received Workman's Compensation for an industrial illness/injury? ☐ Yes ☐ No If yes, explain.

SIGNATURE

It is understood and agreed that any willful misstatement made by me in this application will be sufficient cause for discharge from the Company's service if I have been employed. It is also understood that this employment is subject to satisfactory completion of a physical examination by a company designated physician at the time of employment and at such time as may be required by the company.

Date _____

Signature of applicant _____

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Work experience

If additional space is needed, attach separate sheets

Present or last employment

Name of present or last employer				Type of business		Address	
Starting date		Leaving date		Starting pay	Final pay	Reason for leaving	May we contact?
Month	Year	Month	Year				
Job title (present or last)			Name of supervisor			Supervisor's job title	
Description of work and responsibilities							

Previous employment

Name of next previous employer				Type of business		Address	
Starting date		Leaving date		Starting pay	Final pay	Reason for leaving	May we contact?
Month	Year	Month	Year				
Job title (last)			Name of supervisor			Supervisor's job title	
Description of work and responsibilities							

Name of next previous employer				Type of business		Address	
Starting date		Leaving date		Starting pay	Final pay	Reason for leaving	May we contact?
Month	Year	Month	Year				
Job title (last)			Name of supervisor			Supervisor's job title	
Description of work and responsibilities							

Additional experience

State what you did in any periods not already covered, including part time or self employment

Dates	

Unless otherwise indicated, state any prior work experience with FMC Corporation, its divisions or subsidiaries

Activities

Professional organizations, including offices (Omit union organizations and organizations which would indicate race, creed, color or national origin)	Hobbies and leisure interests

Publications

Title (include patents)	Journal reference or patent number

Work preferences

Kind of work most wanted

Other kinds of work in which interested

Location (preferences or limitations)	Approx. salary range expected	Date available to start work

Previous address

List home address in U.S. for last 5 years.

Dates	Street and number	City	State	Zip

Remarks

Have you ever been convicted of a felony or misdemeanor other than parking or minor traffic violation?

☐ Yes ☐ No If yes, explain fully.

List illnesses, disabilities, and limitations which may affect work performed or should be considered in determining job placement.

Additional remarks relative to your candidacy.

Signature

Date _____

Signature of applicant _____

It is understood and agreed that any willful misstatement made by me in this application will be sufficient cause for discharge from the company's service if I have been employed. It is also understood that this employment is subject to satisfactory completion of a physical examination by a company designated physician at the time of employment and at such time as may be required by the company.

Form 808—Rev. March 1977

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FMC

FMC Corporation An equal opportunity employer

Application for employment | salaried personnel

It is the policy of FMC Corporation to provide equal opportunity for all qualified persons and not to discriminate against any employee or applicant for employment because of race, color, religion, sex, national origin, age or handicap.

Date

Return completed application to

FMC Corporation
Fluid Control Division
2825 West Washington, P. O. Box 1377
Stephenville, Texas 76401, (817)968-2181

Identification

(print) First name	Middle name	Last name		Social security number	
Local address Street and number	City	State	Zip	Telephone	
Permanent address Street and number	City	State	Zip	Telephone	
Name of person to be notified in case of emergency				Telephone	
Address Street and number		City	State	Zip	
Are you a U.S. citizen? If no, do you have a legal right to remain in the U.S.? ☐ Yes ☐ No ☐ Yes ☐ No If yes, how long?					

U S military service

Branch of U S service	Date entered Month	Year	Date discharged Month	Year	Rank at discharge	Type of discharge
Nature of duties and any special training and honors received						
Present draft, reserve or military status						

References

If applying for professional or technical position, include at least one professional reference familiar with your work performance.

Name (not a relative or employer)	Complete mailing address	Occupation

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Education and training

Education

Name of school	Location	Dates attended From	Dates attended To	Years credit	Year grad	Degree	Course or major subject
High school							
Business or trade school							
College or university							
Graduate study							
Other							

Note: A copy of your college transcript should accompany this application if you graduated from college within last 5 years.

High school and undergraduate record

	High school	College (undergraduate)	
Scholastic standing (estimate if not known)	Average grade, standing in class, etc.	Average grade, gradepoint, standing, etc.	
Scholastic honors		Significant courses in major subject if attended within last 5 years	
Significant extracurricular activities if attended within last 5 years			
		Expenses earned (percent and how earned)	

Graduate study

Field of graduate study	Scholarships, fellowships, assistantships, etc.	Name of major professor
Courses in specialized fields	Research problems	

Special training or qualifications

Languages spoken fluently	Languages read fluently	Factory or shop machines operated
Office machines operated		
Typing speed _____ wpm	Shorthand speed _____ wpm	

Describe any other special training or skills which are in any way related to the kind of work you want to do.

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GENERAL DYNAMICS
Fort Worth Division
P. O. Box 748, Fort Worth, Texas 76101 (Mail Zone 1862)

APPLICATION FOR EMPLOYMENT

GENERAL DYNAMICS IS AN EQUAL OPPORTUNITY EMPLOYER AND COMPLIES WITH ALL LAWS PROHIBITING DISCRIMINATION

DATE OF APPLICATION

GENERAL INSTRUCTIONS: It is important that you fill out this application blank thoroughly and completely. Please attach a supplementary sheet to this application with additional information if there is insufficient space provided under any of the entries below. A careful preplacement physical examination is required for all new employes, at which time consideration will be given to any physical condition which may have a bearing on placing you safely and suitably. This application must be filled out by you personally. Military discharge papers, birth certificate, and social security card are required at time of interview.

Name (Last) (First) (Middle - No Initial)

☐ Male ☐ Female

Date of Birth | Height | Weight | Social Security No.

Present Address (Number) (Street) (City) (State) (Zip Code) (Phone)

Permanent Address (Number) (Street) (City) (State) (Zip Code) (Phone)

U. S. Citizen ☐ YES ☐ NO If not a citizen, enter Alien Card No.

Do you have any relatives working at General Dynamics? ☐ YES ☐ NO (If "Yes", indicate name, relationship, division where employed)

Have you ever worked for General Dynamics? ☐ YES ☐ NO (If "Yes", indicate where, when, which division)

List ailments, physical defects, previous injuries (If none, write "NONE").

Have you ever been convicted for any violation of any federal, state, county, or municipal law? Include all courts-martial while in military service. Do not include traffic violations in which the only penalty was a fine of $25 or less. Write in YES or NO. If "YES", give date, place, charge, and disposition in the following space. Attach sheet if necessary.

EDUCATION - Overflow information may be put on another sheet and attached (If college graduate, copy of college transcript or course outline would be helpful).

TYPE	NAME	LOCATION	MONTH & YEAR ATTENDED FROM	MONTH & YEAR ATTENDED TO	MAJOR AND MINOR COURSES	DEGREES CONFERRED AND DATE
HIGH SCHOOL						
COLLEGE OR UNIVERSITY						
TRADE SCHOOL OR OTHER SPECIAL TRAINING						

GRADE POINT AVERAGE: Undergraduate ____ Out of Possible ____ Graduate ____ Out of Possible ____

Approximate Rank in Class ____ of ____

Percent of College Expenses Earned ____ %

Graduate Thesis Subject

Extra Curricular Activities

Future Educational Plans

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MPLOYMENT RECORD - List employers in the order in which you worked for them, showing most recent employer first. Include military service, periods of unemployment and self employment, such as farming, etc

FIRM NAME AND ADDRESS (GIVE COMPLETE ADDRESS)	MONTH AND YEAR EMPLOYED	POSITION AND DUTIES (More Complete Details May Be Furnished by Attaching Resume or by Utilizing Space in Remarks)	BASE RATE OF PAY	REASON FOR LEAVING
Employer	Started		Starting	
Street Address				
City	Terminated		Ending	
State Zip Code		Supervisor		
Employer	Started		Starting	
Street Address				
City	Terminated		Ending	
State Zip Code		Supervisor		
Employer	Started		Starting	
Street Address				
City	Terminated		Ending	
State Zip Code		Supervisor		
Employer	Started		Starting	
Street Address				
City	Terminated		Ending	
State Zip Code		Supervisor		
Employer	Started		Starting	
Street Address				
City	Terminated		Ending	
State Zip Code		Supervisor		
Employer	Started		Starting	
Street Address				
City	Terminated		Ending	
State Zip Code		Supervisor		
Employer	Started		Starting	
Street Address				
City	Terminated		Ending	
State Zip Code		Supervisor		

May we question your present employer?	Will you work any shift?	Will you work overtime?	Will you work Saturday?	Will you work Sunday?
☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO	☐ YES ☐ NO

ind type of work preferred

What is your minimum salary requirement?

Date available for employment

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Have you ever been granted a security clearance? Answer Yes or No. _____ If answer is "Yes" indicate level of clearance and where employed when cleared.

Have you ever had a security clearance suspended, denied, or revoked? Answer Yes or No. _____ If answer is "Yes" where were you employed at that time?

Except for reasons of a reduction in force, have you ever terminated employment while a request or application for a security clearance was pending? Answer Yes or No. _____ If answer is "Yes" where were you employed at that time?

REFERENCES - Six required - use full names.
PROFESSIONAL - Previous supervisors preferred - If so, please indicate.

All References Must Have Complete HOME Address NOT PROFESSIONAL Address

COMPLETE NAME	BUSINESS	COMPLETE ADDRESS

CHARACTER - Do not list relatives or former employers.

All References Must Have Complete HOME Address NOT PROFESSIONAL Address

COMPLETE NAME	BUSINESS	COMPLETE ADDRESS

MISCELLANEOUS - Overflow information may be put on another sheet and attached.

Technical Interest

Publications

Are you now, or have you ever been a member of, or affiliated or associated with any organization, association, movement, group or combination of persons (1) which advocates or advocated the overthrow of our Constitutional Form of Government, (2) which has or had adopted a policy of advocating or approving the commission of acts of force or violence to deny other persons their rights under the Constitution of the United States, or (3) which seeks or sought to alter the form of Government of the United States by unconstitutional means? ☐ YES ☐ NO (If "Yes," list name(s) of such organization(s), association(s), movement(s), group(s) or combination of persons.)

SOCIETIES AND ORGANIZATIONS - List all societies or organizations to which you have belonged in the last 10 years (if none, write "NONE"). Omit labor organizations or organizations which might indicate race, creed, color or national origin.

ORGANIZATION NAME	CITY	STATE	YEAR FROM	YEAR TO	OFFICES HELD

ORGANIZATION NAME	CITY	STATE	YEAR FROM	YEAR TO	OFFICES HELD

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VOLUNTARY INFORMATION

TO BE COMPLETED BY APPLICANT:

IN ORDER TO COMPLY WITH REPORTING REQUIREMENTS UNDER FEDERAL LAW, WE ASK YOU TO PLEASE COMPLETE THIS FORM. THE INFORMATION YOU ARE ASKED TO GIVE WILL BE USED SOLELY FOR PURPOSES OF COMPLIANCE WITH FEDERAL REQUIREMENTS. IT WILL NOT BE USED FOR HIRING, PLACEMENT OR ANY OTHER DECISION RELATING TO TERMS AND CONDITIONS OF EMPLOYMENT.

DO NOT HESITATE TO ASK FOR ASSISTANCE IF YOU HAVE ANY DIFFICULTY COMPLETING THIS FORM. THANK YOU VERY MUCH FOR YOUR COOPERATION.

PLEASE PRINT

LAST NAME	*FIRST NAME*	*MI*		*SEX*
			MO DAY YEAR *APPL DATE*	*Male ____ M* *Female ____ F*

RACE ____ *WHITE 0* ____ *BLACK 1* ____ *HISPANIC 2*
____ *ASIAN OR PACIFIC ISLANDER 3* ____ *AMERICAN INDIAN OR ALASKAN NATIVE 4*

HANDICAPPED	*VETERAN OF*	*DISABLED*	
YES ____ *NO* ____	*YES* ____ *VIETNAM ERA* *NO* ____	*YES* ____ *VETERAN* *NO* ____	*MO DAY YEAR*
(Note 1)	*(Note 2)*	*(Note 3)*	*BIRTH DATE*

NOTE 1 – HANDICAPPED – "HANDICAPPED INDIVIDUAL" MEANS ANY PERSON WHO (1) HAS A PHYSICAL OR MENTAL IMPAIRMENT WHICH SUBSTANTIALLY LIMITS ONE OR MORE OF SUCH PERSON'S MAJOR LIFE ACTIVITIES, (2) HAS A RECORD OF SUCH IMPAIRMENT OR (3) IS REGARDED AS HAVING SUCH AN IMPAIRMENT.

NOTE 2 – VETERAN OF VIETNAM ERA – "VETERAN OF VIETNAM ERA" MEANS A PERSON WHO (i) SERVED ON ACTIVE DUTY FOR A PERIOD OF MORE THAN 180 DAYS, ANY PART OF WHICH OCCURRED BETWEEN AUGUST 5, 1964 AND MAY 7, 1975, AND WAS DISCHARGED OR RELEASED THEREFROM WITH OTHER THAN A DISHONORABLE DISCHARGE, OR (ii) WAS DISCHARGED OR RELEASED FROM ACTIVE DUTY FOR A SERVICE-CONNECTED DISABILITY IF ANY PART OF SUCH ACTIVE DUTY WAS PERFORMED BETWEEN AUGUST 5, 1964 AND MAY 7, 1975.

NOTE 3 – DISABLED VETERAN – A DISABLED VETERAN IS A PERSON ENTITLED TO DISABILITY COMPENSATION UNDER LAWS ADMINISTERED BY THE VA FOR DISABILITY RATED AT 30 PERCENT OR MORE, OR A PERSON WHOSE DISCHARGE OR RELEASE FROM ACTIVE DUTY WAS FOR A DISABILITY INCURRED OR AGGRAVATED IN THE LINE OF DUTY.

DO NOT WRITE BELOW THIS LINE

CONTROL NUMBER

ROUTED YES ☐ NO ☐

CARD TYPE FUNCTON [A]

TO

PRIMARY ☐

SECONDARY ☐ SOURCE ☐

EDUCATIONAL DATA

UNIVERSITY	DEG	DISC	GPA	QTL	MO YEAR DATE	MO YEAR REL EXPER

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RESIDENCES — List all your residence addresses for the past 5 years. If you were in the Armed Forces, list addresses just prior to entering (list most recent address first).

STREET ADDRESS	CITY	STATE	MONTH & YEAR FROM	MONTH & YEAR TO

STREET ADDRESS	CITY	STATE	MONTH & YEAR FROM	MONTH & YEAR TO

Draft Classification	Deferment Expires	Local Draft Board No. and Address

U.S. Veteran ☐ YES ☐ NO	Branch of Service	Date Entered	Rank	Type of Discharge	Date of Discharge	Rank

Member Reserve ☐ YES ☐ NO ☐ ACTIVE ☐ INACTIVE	If "YES", where?	Member Advanced R.O.T.C. Unit ☐ YES ☐ NO	If "YES", where?

How were you referred to General Dynamics?

In case of emergency notify (Name) (Address) (Phone No.)

REMARKS

I hereby certify that the answers by me to the foregoing questions and statements made are true and correct, without reservations of any kind whatsoever, and that no attempt has been made by me to conceal pertinent information. If employment is obtained under this application, I will willingly comply with all orders, rules, and regulations of this Company. I agree to submit to physical examination. I also authorize my former employers, schools, and personal references to give any information they may have regarding me, whether or not it is on their record. I hereby release them and their company from all liability for issuing same. It is understood that all facts are open to investigation by General Dynamics Corporation - and that if upon investigation, anything contained in this application is found to be false or misleading, I understand I will be subject to dismissal from employment at any time during the period of my employment and agree to hold General Dynamics Corporation and persons named herein blameless in that event.

Date (mo/day/yr)

DEPARTMENT 3
FWP 185-4-7-60

SIGNATURE OF APPLICANT